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THE USE OF PARAFFIN SPHERES IN FROST'S OPERATION (MODIFIED MULES'S), WITH A REPORT OF TWENTY-THREE CASES.

By CHARLES NELSON SPRATT, B.S., M.D.,
MINNEAPOLIS,

LATE SENIOR OPHTHALMIC HOUSE SURGEON, MASS. CHARITABLE EYE AND EAR INFIRMARY.

ALTHOUGH the modern operation of enucleation was devised in 1841, by Bonnet,[1] no practical method was suggested for obtaining a more movable stump until 1885, when Mules[2] published the operation that now bears his name. This consisted in removing the contents of the eye, taking special care to remove all of the uveal tract, and the substitution of an artificial vitreous in the form of a hollow glass ball. The sclera and conjunctiva were sutured over this. In a later paper,[3] he advised separate closure of the sclera and conjunctiva—the former by a vertical, and the latter by a horizontal, line of sutures. Verry[4] collected 343 cases of this operation, 269 of which had been followed; 21.3 % of these were failures, and in 78.7 % good results were obtained. In 1886, Frost[5] further modified this operation by inserting the glass ball in Tenon's capsule instead of within the globe itself, and suturing the muscles and conjunctiva over it. This was a decided improvement over Mules's operation, as it combined the advantages of the simple enucleation with those of Mules's operation, but without the objections of either. About the same time, Lang[6] described the same method and reported sixteen cases in which celluloid or glass spheres were placed in Tenon's capsule, with but two failures.

The cosmetic results after the typical or modified Mules's operation are superior to those after simple enucleation. Occasionally, it is true, after the latter operation, especially if a Snellen eye is worn, a good cosmetic result is obtained. These eyes are, however, expensive and are not so easily obtained as the shell eye. After Mules's operation, a good movable stump fills the cavity behind the artificial eye and prevents the accumulation of secretions. The eye is pressed forward, so that its corneal surface comes in contact with the lids, thus lessening the opportunity for the lodgment of dust, with the consequent irritation of the conjunctiva. The disagreeable effect of the sunken lids, so frequently present after simple enucleation, is absent. The motion of any artificial eye is limited by the depth of the cul-de-sac and, of course, we can never expect perfect lateral motion, but the mobility after Mules's operation is greater than after simple enucleation.

Evisceration, without the insertion of an artificial vitreous, as in the Mules operation, has been suggested as a substitute for enucleation. This operation was first accidentally done in 1881, by Fröhlich,[7] who, in attempting to extract a foreign body, emptied the contents of the globe. Leaving the denuded sclera to the unaided efforts of nature, he found the ultimate result superior to that obtained after enucleation. This operation was recommended by A. von Graefe,[8] in 1884, to obviate the possible danger of meningitis. While this operation gives a movable stump, the sclera atrophies, and the ultimate result is no better than after simple enucleation. There are, however, objections to evisceration and Mules's operation, which do not apply to enucleation, or the insertion of a globe in Tenon's capsule—Frost's operation:

(1) Greater danger of sympathetic ophthalmia than after enucleation.

(2) Certain cases (*e. g.*, malignant intraocular tumors) are not suitable.

(3) Small tumors, malignant or otherwise, might be overlooked.

(4) Eye is of no value for microscopic examination or macroscopic specimens.

(5) Severe reaction, especially after simple evisceration, and prolonged convalescence.

Since Mules's paper, various solid or semi-solid, absorbable or non-absorbable substances, either as simple spheres, or made in the form of filigree or fenestrated globes to catch the granulations, have been suggested as a substitute for the glass globes.

Among these substances we find: gold or silver spheres (Keal)[9]; celluloid (Lang)[10]; fenestrated aluminum globes (Bryant)[11]; hard and soft rubber (Pick)[12]; sponge (Belt)[13]; silk and catgut (Bourgeois)[14]; wire globes (Landman)[15]; agar-agar (Suker)[16]; vaseline injections into tissue of orbit 2–3 weeks after enucleation (Rohmer)[17]; fat from gluteal region (Barraquer)[18]; and even the implantation of rabbit's eyes (Bradford)[19]; (Lagrange).[20]

Following Gersuny's[21] work on the use of paraffin in general surgery, Brockaert[22] (1901) used injections of this material in ocular prothesis. Ramsey,[23] 1903, reported twenty-two cases with two failures following the injection of paraffin in the scleral cavity, and in a later article[24] twelve additional cases, making a total of thirty-four cases with three failures. The sclera was closed by a purse-string suture. Suker[25] about the same time reported a quite similar method.

Oatman,[26] in a paper read Nov. 17, 1902, before the N. Y. Academy, reported three cases in which solid paraffin balls were placed in the scleral cavity, while Alter,[27] 1903, published one case in which a paraffin ball was placed in Tenon's capsule.

Of all the various substances suggested as an aid in obtaining a permanent movable stump on which to wear an artificial eye, paraffin is the most satisfactory. It is cheap and can be easily obtained; a lump can be cut to the desired size; no extra instrument is necessary to introduce the sphere into the cavity; it is non-irritating, and moulds itself to the shape of the cavity left after removal of the eye. Not only is it finally surrounded by a fibrous capsule, but in time strands of tissue penetrate the mass, and the danger of extrusion is reduced to a minimum. The possibilities

of such an accident, after the reaction of the operation has disappeared, is very remote.

From experimental work on rabbits, Hertel[38] found that the softer paraffin (60° C.), especially after injecting it into the tissues, was partially absorbed. This did not occur if a globe of hard paraffin (78° C.) was introduced into Tenon's capsule or into the scleral cavity. In the latter case, the growth of connective tissue into the mass was less marked than after use of the soft paraffin, although it was soon surrounded by a fibrous capsule.

During the past seven months, the writer has inserted paraffin globes in Tenon's capsule in thirteen cases. In addition, four cases done by Dr. Heffernan and six cases by Dr. Ellis, both of the house staff of the Mass. Charitable Eye and Ear Infirmary, have been kindly placed at the writer's disposal. Of these twenty-three cases, all except three have been seen or heard from recently. Among these twenty-three cases there was one failure. Three cases were lost sight of, but as each patient was told of the possibility of the paraffin being extruded and was instructed to report at once if his eye gave any further trouble, it is unlikely that the paraffin has been extruded. The one failure was in a man whose eye was enucleated for collapsed globe following a wound of the ciliary region. A large-sized paraffin sphere was placed in Tenon's capsule and the muscles sutured over it. On the fifth day the paraffin presented, and it was thought best to remove it, although the reaction was not marked, and there were no signs of infection. The cause of this failure was thought to be due to excessive tension on the sutures, causing them to cut through the muscles. All the cases, except two, were males. The ages were between six and seventy-nine years, the majority being between twenty and thirty-five; four were over fifty years. So far as could be seen, healing occurred as rapidly in these latter cases as in the younger.

The causes for enucleating were as follows: Injuries 8, disorganized globe 8, staphyloma 2, glaucoma 2, and kerato-iritis 3.

The average duration of chemosis was about seven days.

In one-fourth of the cases, at the end of five days the chemosis and swelling of the lids had disappeared. In only two cases was the swelling prolonged more than two weeks. From the above cases it will be seen that the convalescence is slightly more prolonged than after enucleation. This can be quite easily explained by the fact that the paraffin occupies part of the orbit which in simple enucleation is filled by the chemotic conjunctiva.

The spheres are prepared as follows: Paraffin, with a melting-point of about 60° C., is melted and filtered through ordinary filter-paper into clean test-tubes. These are stopped with cotton and placed in a steam sterilizer. When these have become cool and the paraffin is solid, the glass is heated in hot water or over a flame until the layer of wax next to the glass is liquid. The central solid paraffin rod is readily removed and placed in a warm solution of bichloride. With a knife, this long candle-like piece of wax is divided into suitable-sized pieces and while yet warm is rolled into spheres. During this process, rubber gloves should be worn. The spheres are kept for future use in a wide-mouthed bottle containing a 5 % solution of formalin. The most convenient-sized sphere is 17*mm.* It is a good plan to have several sizes ranging in diameter from 1.5–2*cm*, although the larger sizes can be quickly cut down to a smaller size.

The operation done by the writer is as follows: The patient, being under a general anæsthetic, the skin about the eye and face is cleaned with soap and water followed by alcohol, ether, and bichloride solution. The conjunctival sac is flushed with bichloride (1 : 5000). A double layer of gauze, with an opening over the eye to be operated on, is placed over the face and ether cone. This prevents the sutures and the hands of the operator from coming in contact with the ether inhaler and aids materially in maintaining a clean field of operation. Aseptic precautions should be observed, as an infection is certain to be followed by failure. The conjunctiva is divided close to the limbus and dissected backward beyond the insertion of the recti muscles. These are picked up on a strabismus hook and separated from the surrounding tissue. Before dividing the tendons

from their insertion in the sclera, each is caught by a silk suture or held by a small clamp. This prevents retraction of the muscle and the possibility of losing it. The writer uses four Halsted hemostats known as the "mosquito" pattern. The use of these forceps saves unnecessary puncture of the tendon with the needle and shortens the time of the operation materially. After dividing the tendons close to their insertions, the globe is enucleated in the usual manner. A paraffin globe is then dipped in bichloride to remove the formalin, and cut, if necessary, to the proper size. The globe is seized with a pair of ordinary forceps and placed in Tenon's capsule. An elaborate introducer is entirely unnecessary as the sphere can be placed in position with almost any instrument.

The superior rectus is sutured to the inferior by a mattress or U suture and the two lateral recti by a similar suture. A slender full-curve needle threaded with No. 00 chromicized catgut should be used. The large needles tear the tendon unnecessarily and the plain catgut is too rapidly absorbed. To prevent the muscle loops from slipping back over the globe and to give a common point of insertion, an additional suture is placed so as to include each muscle at the crossing of the two loops. Tenon's capsule is closed over the globe by a catgut purse-string suture. This relieves the tension on the muscle sutures, covers the globe with an extra layer of tissue, and prevents the ball from slipping out between the muscles. The conjunctiva is then closed with a purse-string, making, in all, three layers.

Care must be taken during the operation not to puncture the tendons unnecessarily, as each needle puncture causes the fibres to separate and a possible cutting through of the sutures. Too large a sphere should not be used, as this places tension on the sutures. In the adult a globe *17mm* in diameter will be found the most suitable size. After the enucleation the hemorrhage may be rather free, but the insertion of the paraffin checks this. No irrigation is used during the operation. A firm gauze dressing is placed over the eye. This is changed daily for the next four or five days and then discontinued. The pressure bandage has

been found to lessen the subsequent chemosis. The reaction following the operation is about the same as after an evisceration. Chemosis, as a rule, lasts less than a week, but may, in exceptional cases, continue longer. One patient was discharged from the hospital with no chemosis on the fifth day. Two cases had thickened conjunctivæ thirty and thirty-five days. The writer has, however, seen chemosis and ecchymosis eight weeks after a simple enucleation.

The writer believes that the insertion of a paraffin sphere in Tenon's capsule is the operation of choice in all cases requiring the removal of an eye, except when a malignant growth involves the orbital tissue or panophthalmitis is present. In the former case, exenteration of the orbit; in the latter condition, evisceration with good free drainage of the scleral cavity, are the operations preferred.

Conclusions: The modified Mules or Frost operation combines the cosmetic results of Mules's with the advantages of simple enucleation. These are:

1. Good cosmetic result is obtained; the artificial eye has good motion; the eye does not have a receding appearance; and the glass is in contact with the lids.
2. Secretions will not accumulate in the hollow behind the eye, as this is occupied by the stump.
3. Globe is preserved *in toto* for microscopic or macroscopic preparations.
4. No danger of overlooking malignant intraocular tumors.
5. Best prophylaxis against sympathetic ophthalmia.

Paraffin is the most suitable material for the prothesis:

1. It is non-irritating and least likely to be extruded.
2. Spheres can be easily made and are inexpensive.
3. No danger of being broken.
4. Paraffin adapts itself to the shape of the cavity, is soon surrounded by a fibrous capsule, and is firmly held in place by connective-tissue down growths.

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A CASE OF PROBABLE RUPTURE OF THE OPTIC NERVE.

By Dr. WALTER N. SHARP, Indianapolis, Ind.

Mr. H. G., fifty-five years old, while climbing a fence with an umbrella in hand, September 10, 1903, fell, bringing the weight of the upper part of the body on the small end of the umbrella stick which struck him in the inner canthus of the left eye. I saw him three and a half hours after the accident. The lids were œdematous, ecchymosed, and tense—so tense, in fact, they could not be separated, and a complete examination could not be made at that time, except so far as to determine that vision was completely destroyed. According to the patient's testimony, he was blind immediately after the accident. Blood flowed from a supposed conjunctival wound, also from the left nostril. There were no crepitation nor other symptoms of fracture of the orbital walls or sinuses. Pain was so intense as to cause faintness and nausea. The ocular conjunctiva, as much as could be seen of it, protruded between the lids. The pupil was dilated. I removed the patient to a hospital where leeches were applied followed by iced applications. A saline purge was given and the eye cleansed with a saturated boric-acid solution every two hours. This treatment was continued for two days, when the œdema was so much reduced as to admit of further examination. A small laceration was discovered in the conjunctiva, about *2mm* above and to the inner portion of the upper punctum. This was barely large enough to admit a number six lachrymal probe, which was pushed in freely in the direction of the upper and inner portion of the globe. After withdrawing the probe, a flow of about one drachm of black syrupy blood followed. The cold applications were discontinued and a compress bandage applied. The following day the œdema was still less and I was enabled to make an

ophthalmoscopic examination. The veins were distended and the arteries nearly empty; the nerve head and retina œdematous; the media somewhat hazy and the macula indistinct. No hemorrhagic spots were visible. The globe was displaced downwards about 3*mm*, and the movement upward and inward was impaired. Ecchymosis appeared in the lids of the right eye three days after the accident, and two days later the bridge of the nose became discolored. No pain whatever was experienced after the first few hours of the accident. The compress bandage was continued for several days and potassium iodide was given to promote absorption. The slight wound was kept open and probing resorted to every day under aseptic precautions. After each probing, blood flowed from the wound, from one-quarter to one drachm, growing thinner and lighter in color each time. The œdema gradually subsided and the globe, by degrees, receded to its normal position. The œdema of the fundus also disappeared and the veins became less distended and the arterial circulation was gradually restored. The ophthalmoscopic appearance was normal, except the condition above referred to, and the gradual whitening of the optic disk. Complete atrophy of the nerve ensued, despite massage, strychnia, etc. The patient is totally blind in the injured eye. The pupil dilates when the right eye is covered, and does not react to light. The motion of the globe is well controlled by the extrinsic muscles.

The case seems worthy of report for several reasons: The cause of the accident—by the small and dirty end of an umbrella stick; the great amount of contusion and damage done to the deeper parts of the orbit, and so small a laceration; the escape of the globe itself from rupture; the appearance of ecchymosis of the fellow eyelid three days after the accident without trace of intervening ecchymosis; no trace of sepsis at any time; the absence of pain after a few hours; the absorption of the clot, and the subsidence of the œdema in so short a time—ten days—without radical surgical interference or injections; and now, more than a year after the accident, there is no divergence as is usually the case in monolateral blindness. From the sudden loss of vision and the absence of symptoms of orbital-wall fracture or sinus involvement, my diagnosis was probable rupture of the optic nerve.

CONGENITAL DEFICIENCY OF ABDUCTION, ASSOCIATED WITH IMPAIRMENT OF ADDUCTION, RETRACTION MOVEMENTS, CONTRACTION OF THE PALPEBRAL FISSURE AND OBLIQUE MOVEMENTS OF THE EYE.

By Dr. ALEXANDER DUANE, New York.

ATTENTION has been repeatedly called to a special class of congenital deficiency of movement of the eye characterized by all or some of the following peculiarities:

1. Complete, or less often partial, absence of outward movement in the affected eye.

2. Partial, or rarely complete, deficiency of movement inward of the affected eye.

3. Retraction of the affected eye into the orbit when it is adducted.

4. A sharply oblique movement of the affected eye either up and in or down and in when it is adducted.

5. Partial closure of the eyelids (pseudo-ptosis) of the affected eye when it is adducted.

6. Paresis, or at least marked deficiency of convergence, the affected eye remaining fixed in the primary position while the sound eye is converging.

This condition has been described more or less adequately by various authors, Collins,[15] Sinclair,[9] Türk,[10, 14] Bahr,[11] Friedenwald, [6, 12] and others; also, except so far as concerns the retraction, by Kunn.[7]

The first complete account, however, was given by Wolff,[16] who described the symptoms with more accuracy

and fulness than had been done before, and gave also a well considered presentation of the different theories that have been offered to explain the retraction. A subsequent paper by Axenfeld and Schürenberg[35] is a valuable contribution to the pathology of the condition. Continuing the work done by these two authors and by Wolff, Evans[37] gave a résumé of 27 cases, including 2 of his own, together with an excellent description of the symptoms and objective appearances.

Most of these authors have considered the condition mainly with reference to the retraction. But this, although an extremely frequent symptom, is not invariably present, and when present is sometimes but very little marked even when the other symptoms are prominent and typical. Hence it is not an absolutely essential feature of the syndrome—its absence, as Axenfeld and Schürenberg pointed out, being due to special causal conditions.

It is the aim of the present paper to collate all of Evans's cases with cases that have occurred in the author's practice and with others that are accessible in literature or in the case-books of his colleagues. In this connection the author wishes to express his sincere thanks to a number of fellow ophthalmologists, who in response to his inquiries kindly took the time and trouble to furnish him with the case-histories cited below.

Not strictly belonging in this category, but usually cited as an instance of retraction movements, is Heuck's case.*

Male, eighteen. Right eye almost immobile; it is directed 32° down, and is so firmly fixed that even under narcosis it cannot be drawn up with forceps. Enophthalmus slight in primary position; some retraction on any energetic attempt to move the eye. When attempt is made to look down and in, vertical meridian rotates to right. No spontaneous diplopia. In looking in different directions, moves head instead of eyes.

Dissection showed that the superior and external recti were attached too far back. Internal and inferior recti not examined.

* This is Case 1 of Evans's list, but Evans's description is inaccurate, applying apparently not to this case but to another one, illustrating a different kind of congenital anomaly.

The following are authentic cases of the condition in question:

Case 1. HIRSCHBERG, J.[1] [Case 5 of Kunn's list (7).]
Case 2. PFLÜGER.[3] [Case 10 of Kunn's list (7).]
Case 3. PFLÜGER.[3] [Case 11 of Kunn's list (7).]
Case 4. GRAEFE, A.[4] [Case 20 of Kunn's list (7).]
Case 5. STILLING, J.[5] [Case 2 of Evans's synopsis (27).]
Cases 6 to 9. FRIEDENWALD, H.[6, 13]
Case 10. KUNN, C.[7]; also described by WOLFF[16] and DUANE.[19] [Case 69 of Kunn's list and Case 18 of Evans's list.]
Cases 11, 12. KUNN, C.[7] Also described by WOLFF.[16] [Cases 70, 71, of Kunn's and Cases 19, 20, of Evans's list.]
Case 13. KUNN, C.[7] [Case 73 of Kunn's list.]
Case 14. RAIA, V. L.[8]
Case 15. PARKER, reported by SINCLAIR.[9] [Case 3 of Evans's list.]
Cases 16, 17. NETTLESHIP, E., reported by SINCLAIR.[9] [Cases 4 and 5 of Evans's list.]
Cases 18, 19. MACLEHOSE, reported by SINCLAIR.[9] [Cases 6 and 7 of Evans's list.]
Cases 20, 21. TÜRK.[10] [Cases 8 and 9 of Evans's list.]
Case 22. BAHR.[11] [Case 14 of Evans's list.]
Case 23. BRAUNSCHWEIG.[12] Reported by AXENFELD and SCHÜRENBERG.[23] [Case 12 of Evans's list.]
Case 24. TÜRK.[14] [Case 10 of Evans's list.]
Case 25. COLLINS, E. T.[15] [Case 11 of Evans's list.]
Case 26. INOUYE.[20] Reported by AXENFELD and SCHÜRENBERG.[23] [Case 15 of Evans's list.]
Cases 27, 28. WOLFF, J.[16] [Cases 16 and 17 of Evans's list.]
Case 29. ALLING, A. N.[17] [Case 22 of Evans's list.]
Case 30. KNAPP, H.[18] [Case 21 of Evans's list.]
Case 31. EATON, F. B.[21]
Cases 32, 33, 34. AXENFELD, T., and SCHÜRENBERG, E.[23] [Cases 23, 24, and 25 of Evans's list.]
Case 35. ZUR NEDDEN.[25]
Cases 36, 37. EVANS, J. J.[27]
Case 38. SPULER, R.[28]

CASE 39.—WEEKS, JOHN E.[22] Male; twenty. No spontaneous diplopia. Holds head directed 10° to the right and

about 5° down. In primary position there is esophoria, and L enophthalmus of 1.5*mm*. L palpebral fissure 8*mm*. L eye can move out 10° beyond middle line; power of outward movement of equal amount when eye is raised, and only 5° when eye is lowered. In moving up and out, L rises above the R, and in moving down and out goes below the R. In moving straight out it protrudes 0.75*mm* and its palpebral fissure widens 0.5*mm*. L can move straight in 17°, and in so doing does not turn up or down, but it retracts 3.5*mm*, and the palpebral fissure contracts to 3*mm*. In looking up and to the right, L rises higher than R and scarcely goes in at all; in looking down and to the right, L goes below R and goes inward about 17°. Movements of R normal and even extensive except outward, where they are slightly limited. [R palpebral fissure appears to narrow somewhat in adduction and also slightly in abduction.] Convergence = 0. Homonymous diplopia in looking to left; crossed diplopia in looking to right; vertical diplopia above and below the horizontal plane. Each eye tested separately shows following rotations:

	R	L
Out	45°	10°
In	60°	17°
Up	35°	27°
Down	65°	55°

Pupils and accommodation normal. V, R $\frac{20}{20}$ + (E); L —0.25 —0.25^c, 85°, $\frac{20}{15}$ —.

Case 40.—De Schweinitz, G. E.[31] Edward, F. G., aged thirty; defect of muscles always present. Symptoms: headache, pain in the eyes, and much wrinkling of the brow. General health good. No other members of the family similarly affected.

R + 2.75 ⊂ + .50^c axis 105°, 6/6.
L + 3.00 ⊂ + .75^c axis 80°, 6/5.

With this glass, the spherical being reduced .75, vision after mydriasis was normal in each eye. With head in the primary position, the Maddox rod showed at 6*m* esophoria 5°, right hyperphoria 9°. Typical retraction movements of R eye, with paresis of R external rectus. R eye sinks in a number of *mm* and goes slightly up, and the lids half close, reducing the normal width of the palpebral fissure fully 50 per cent. when adduction is attempted or on movement up and in and down and in. In the right

field there is homonymous lateral diplopia, which disappears gradually as the test-object is moved to the centre, and is gone when it reaches slightly to the left of the centre of the field. When the object is moved to the left lower field there is vertical diplopia, the right image being lower and to the left of the left image. These measurements were the same whether the patient looked through the correcting glasses or without them. The rotations measured on a perimeter were as follows:

R eye	L eye.
Out, 10°	Average normal rotations
Down and out, 35°	in all directions.
Up and out, 15°	
Up, 40°	
Down, 45°	
Down and in, 30°	
In, 20°	
Up and in, 45°	

CASE 41.—CARPENTER, JOHN T.[31] Female, aged forty. Diplopia since earliest recollection; noticed when looking to left very severe nervous reflex disturbances, car-sickness, etc. Holds head directed to left, and tipped toward right shoulder.* With head directed straight forward, L extreme enophthalmus and L convergent squint of 6°; L palpebral fissure same size as R. L can be abducted *2mm* beyond median line, and abducted still more when above or below the horizontal plane; in abduction, eye comes forward, but width of palpebral fissure does not change. Adduction L subnormal (cornea does not reach inner canthus); eyeball at same time becomes more retracted and moves obliquely up; palpebral fissure does not narrow. Movements of L eye straight up nearly normal; down, somewhat restricted. Movements of R normal. Convergence near-point *9cm* from root of nose. Homonymous diplopia increasing greatly in looking to left; vertical diplopia everywhere except in right upper field where there is single vision. When R eye is screened and L is made to fix, R shows a pronounced secondary deviation, especially in looking to the left and below. R + 0.25 cyl. 90°, $\frac{6}{5}$; L + 0.25 + 0.25 cyl. 90°, $\frac{6}{5}$.

CASE 42.—ALLING, A. N.[31] Female, aged seventeen. Congenital paralysis L externus. L when adducted retracts. Eye

* Evidently to obviate the vertical diplopia.—A. D.

normal except for My. of 1 D. Case exactly like Alling's earlier recorded case. (See No. 29.)

CASE 43.—THOMAS, F. G.[20] Female, aged ten. Holds head turned slightly to left. Occasional momentary diplopia and vertigo. With head directed straight forward, orthophoria. L abduction = 0, but in attempted abduction there is slight rotation upward and slight widening of the palpebral fissure. Power of abduction rather greater than when eye is elevated and rather less when it is depressed. L adduction more nearly normal, but, on looking above horizontal, movement is restricted, and at same time eye makes a marked clockwise rotation about the antero-posterior axis; and there is slight narrowing of the palpebral fissure. In adduction there is a slight tendency of the eye to move obliquely up, this being more marked when the eye is elevated. Restriction in motility of L eye same whether R eye was covered or not. Convergence near-point 20.5*cm* from root of nose. L eye could not be abducted with forceps. In chosen position of head, binocular vision is quite perfect both at distance and near, but in any other position of the head, the left image is at once suppressed. R $\frac{6}{6}$ (+ 1.00 sph. under atropine); L (under atropine) + 0.25 sph ⊃ + 1.00 cyl. 120°, $\frac{6}{6}$. Symptoms entirely relieved by use of glasses, which patient of her own accord uses constantly.

CASE 44.—GRADLE, H.[24] Female, aged twenty-two. Asthenopia due to refractive error. No spontaneous diplopia. Holds head straight. In primary position orthophoria; slight enophthalmus L. L abduction = 0; adduction 1–2*mm* and as eye turns in, it retracts, turns up, and becomes intorted. Relations of palpebral fissure not noted. Convergence = 0. When R eye is covered and L fixes, L shows a pronounced secondary deviation.

R + 6.00 + 1.00 cyl. 90°, $\frac{20}{20}$; L + 6.00 + 2.00 cyl. 180°, $\frac{20}{20}$.

CASES 45, 46.—SCHAPRINGER, A.[26, 27]

CASE 47.—SCHAPRINGER, A.[25] Female, aged thirty. L enophthalmus in primary position. L abduction = 0; adduction restricted and difficult, and associated with slight retraction. R V and refraction normal; L $\frac{10}{200}$; apparently normal.

The following cases occurred in my own practice:

CASE 48.—DUANE, A.[19] Bertha S.; eight. Deviation of eyes noticed since birth. Used to hold head to right, and does so still

when looking intently at anything. Left eye cannot move out beyond median line. When eyes are carried horizontally to the right, the left eye suddenly flies upward and becomes buried beneath the upper lid. In associated movements in the lower field, the left eye moves normally with the right. Behind the screen the left eye deviates high up and somewhat in. Deviation of either eye behind the screen about equal. No double images attainable. V: R $\frac{20}{40}$, with + 1.00 D $\frac{20}{30}$; L $\frac{20}{70}$.

Case 49.—Duane, A.[19] Bella S., aged twenty. Headache, unilateral or bilateral, and pain in left eye noted for two years, since she has been using her eyes for close work. Asthenopia. Vertigo slight. No spontaneous diplopia.

Under homatropine, R + 1.25 D $\frac{20}{20}$; L + 1.50 D $\frac{20}{30}$. In the primary position, moderate convergent squint greater for distance than for near. Screen deviation of left eye much more marked than right.

R eye cannot move out beyond the middle line. Movement inward, though varying in amount at different times, restricted (from $\frac{1}{2}$ to $\frac{3}{4}$ of the normal). In looking up and to the right the R eye can move slightly outward, and if then the test object is carried vertically down, the eye moves down and in. So also, in looking down and to the right, the R eye can move slightly outward, and if then the test object is carried straight up, the eye moves up and in.

In looking to the left there is no retraction of R eye, nor any tendency to an oblique movement upward or downward, but R palpebral fissure contracts from a width of 7 or 8*mm* down to 3*mm*. In looking to the right, L palpebral fissure shows a similar contraction.

In the primary position there is homonymous diplopia, which diminishes as the eyes are carried to the left, and when the eyes are turned about 10° to the left there is single vision and true orthophoria. As the eyes are turned still farther to the left, the orthophoria is succeeded by exophoria, and a little farther on (when the eyes are directed 25° to the left) there is crossed diplopia. Near-point of convergence from 7 to 15*cm*.

Case 50.—N. F. V., a man of thirty-one. L eye has never been able to turn out, and whenever he attempts to turn his eyes to the left has diplopia; has to turn his head in order to avoid this. No asthenopia, pain, or vertigo.

Under homatropine: R emmetropic, V = $\frac{14}{14}$; L — 0.25, V =

$\frac{1}{1}\frac{1}{8}$. In the primary position, esophoria of 3° to 5° with binocular single vision, and a prism divergence of 3°. As soon as he looks to the left, gets a marked and increasing homonymous diplopia. In looking up and to the right there is crossed diplopia with the image of the right eye higher (left hyperphoria of 8° or 9°). The left eye can move out only a few degrees beyond the middle line; movement is somewhat restricted. The movement up of both eyes is markedly restricted and painful.

MONOCULAR FIELD OF FIXATION.

	R	L
Out.....	35°	12°
In.....	48°	37°
Up.....	12°	13°
Down.....	63°	55°

Near-point of convergence, from 7 to 12*cm.* Little, if any, impairment of projection in either eye.

CASE 51.—Minnie B., aged sixteen. Headaches frequent, especially in the right temple, also a feeling of tension in the eyes after using them for near work. There seems to have always been something obviously wrong in the appearance of the eye, for during the last 9 years they have been repeatedly examined and she has always been asked if she did not "see double." She has, however, never had any spontaneous diplopia. L eye cannot move out at all beyond the middle line. Movement inward less than normal by 1 or 2*mm.* Movements of R eye normal, except that adduction is also somewhat defective. When she looks to the right, L palpebral fissure contracts from a width of 12 or 13*mm* down to 8*mm.* There is no retraction of the eye when she looks to the right, but there are slight, slow, nystagmoid twitchings in both eyes; when she looks to the left there is sometimes a slight lateral and rotary nystagmus. When the eyes are directed a little above the horizontal plane and carried to the right, L eye shoots obliquely up above the right and also diverges. When the eyes are carried up and to the left, L eye can move out a little beyond the middle line.

In the primary position there is a moderate divergent squint, the deviation of the right eye behind the screen being fully three times as great as that of the left (*i. e.*, it takes a prism of over 30° base in before the right eye, and one of only 10° before the left

eye, to abolish the screen movement). When the eyes are turned slightly to the left the divergent squint is replaced by orthophoria, and as the eyes are turned still farther this almost immediately gives place to a convergent squint. Here again the screen deviation of the right eye (secondary deviation) greatly exceeds the primary deviation of the left eye.

In the primary position there is crossed diplopia with the Maddox rod. No hyperphoria in the primary position with the Maddox rod, but when the eyes are carried up and to the right, there is a left hyperphoria of 15°. There is marked paresis of convergence. In following, with both eyes open, an object carried toward the eyes in the middle line, the left eye remains fixed in the mid-position, while the right eye converges on the object. There appears, however, to be some attempt at convergence, for in this case there is a fairly well-marked convergence-reaction of the pupil. This is also the case if the right eye is made to converge on the object and the left eye is covered. If, however, the right eye is covered and the left is made to converge on the object, the right eye diverges almost to the outer canthus and the pupils do not contract.

The patient ordinarily carries her head turned slightly to the left. Projection with the left eye is somewhat faulty, the finger being carried a little beyond the object when she is looking either to the right or to the left.

At first, examination showed under homatropine R+ 2.00 + 0.50 cyl. 100°, L + 0.75 + 2.50 cyl. 80° and got R + 1.50 + 0.50 cyl. 100° ; L + 2.50 cyl. 80°. Troubles continuing and increasing in spite of this prescription, free tenotomy of right externus was performed. This was done because it was evident that what caused her the most trouble was not the homonymous diplopia in looking to the left, but the crossed diplopia in looking to the right. To have attempted to remedy this by advancing the left internus would have been improper, for advancement done on the affected eye in such cases simply increases the retraction and the sense of tension which the patients complain of. Result, six months after operation: Patient holds head 5°–10° to right and 20° when object is at reading distance. When eyes are directed straight forward, esophoria 5°–6°. In looking to the right, crossed diplopia increasing slowly (up to 12°–14° prism) ; *primary and secondary deviations equal ;* abduction R limited 2–3*mm ;* convergence still very deficient (convergence near-point about

80 *cm.*), and in converging with right eye covered, latter flies far out (excessive secondary deviation). In looking up and to right, L shoots high above R ; in looking down and to left, shoots far below R. In looking to right, moderate contraction of L palpebral fissure ; in looking to left, slight contraction of R and slight dilatation of L palpebral fissure.

Immediate effect of operation was relief of feeling of strain, but this returned two months later, and was finally much benefited by changing her glasses to R + 1.75 + 0.75 cyl. 100°, L + 0.75 + 2.50^{c} 80° ; with these V = R $\frac{1}{1}\frac{6}{8}$; L $\frac{1}{3}\frac{6}{8}$.

Case 52.*—D. T. K., male, aged twenty-two. Asthenopia dolens for ten years, partly relieved by glasses. Occasional vertigo after reading; occasional momentary diplopia for distance and also diplopia (vertical) in reading. Holds head directed about 10° to the right. In this position, esophoria of 4° or 5° (prism) and, with red glass, slight homonymous diplopia. With head straight, there is spontaneous diplopia without the red glass, R converging and also being noticeably higher than L. No enophthalmus in primary position and R palpebral fissure = 10*mm.* R cannot move out beyond the middle line; movement outward somewhat greater when eye is directed downward. In abduction, eye does not protrude, but palpebral fissure widens a little. R moves in to about 1*mm* of caruncle and in so doing it moves obliquely up and retracts 4–5*mm*, and its palpebral fissure narrows to 5*mm*. In looking up and to left, R goes nearly straight up and much higher than the L. Movements of L eye straight up and straight down normal. Movements of R normal. Convergence near-point 25–30*cm* from root of nose. On reading holds book slightly to right. With red glass, homonymous diplopia increasing fast in looking to the right; slight vertical diplopia in this part of field. In looking slightly to left, single vision, changing almost at once to crossed diplopia, which increases fast and is accompanied by a rapidly increasing vertical diplopia (with image of right eye below = right diplopia). The vertical diplopia increases greatly in looking up and to the right, and continues, although constantly diminishing, down to and even some distance below the horizontal plane (= spasm R inf. oblique). Very marked secondary deviation of L eye.—*i. e.*, in looking to right, L eye, when R fixes, deviates excessively in; in looking to left, it deviates excessively out. In the patient's

* For the privilege of examining this case I am indebted to Dr. C. H. May.

chosen position of the gaze with head directed slightly to the right, the screen-deviation of the L eye is 4–5° (prism); when R is covered and L fixes, the (secondary) deviation of the R is 10° to 12°. With head straight, primary deviation is 14° (prism), secondary is 20°. So also at 12 inches, with the object in the median line, the deviation of the R eye out behind the screen is 12°, that of the L is 18°; and a similar disproportion between the primary and secondary outward deviation occurs in looking to the left. With Dr. May's correction, R + 1.00 + 0.50 cyl. 70°; L + 1.50 + 0.50 cyl. 60°; V = $\frac{1}{15}$ each.

Case 53.—K. D., female, aged twenty-six. Asthenopia dolens and headache brought on by work at sewing machine. No diplopia noticed. Holds head directed about 10° to the left; in this position there is orthophoria and no enophthalmus, but L palpebral fissure is *9mm*, while R is 10. L abduction = 0 or at most *2–3mm;* in attempted abduction it does not come forward, nor does the palpebral fissure widen. Power of abduction not greater in upper or lower field than when eye is directed horizontally. L eye can move in to *1-2mm* of caruncle; in adduction, it does not move obliquely up or down, but is retracted *2–3mm*, and palpebral fissure contracts to *7mm*. When the eye is carried far inward it sometimes makes a marked movement of extorsion (vertical meridian rotates outward). Movements up and down normal. R adduction *1–2mm* less than normal, and movement is jerky; palpebral fissure remains of same width when eye is abducted. R adduction apparently normal, and there is no retraction, but palpebral fissure contracts to *8mm*. Convergence near-point *12–17cm;* sometimes eyes make no effort to converge. In primary position, single vision passing almost at once into homonymous diplopia as eyes are turned to the left, and into crossed diplopia as the eyes are turned to the right. No vertical diplopia. In looking to the left, secondary inward deviation of R eye much greater than primary deviation of L; in looking to right, primary and secondary deviations about equal. R $\frac{20}{20}$—; E. L $\frac{20}{40}$—; — 0.75 cyl. 90°, $\frac{20}{30}$. Ordered R plane, L — 0.75 cyl. 90°.

Case 54.— Schapringer, A.[39] Female, aged twenty-two. Has always had diplopia when she turned her eyes in a certain direction. R and L emmetropic and V normal. R movements normal. L abduction slightly impaired (cornea does not go quite to outer commissure); when she tries to look to right, L eye retracts slightly and goes almost straight upward; palpebral

fissure at same time contracts markedly. When she looks down and to the right, adduction much more extensive. No enophthalmus in primary position. Usually holds head turned to the right and tilted toward left shoulder. If head is directed straight, L strabismus divergens and sursumvergens.

The findings in these cases may be summarized as follows:

OBJECTIVE SYMPTOMS.

(*a*) *Restriction of Abduction.*—In 41 of the cases abduction was altogether or almost altogether absent, while in 12 it was more or less deficient. In one (Case 54) it was only slightly restricted. Even, however, when it was impossible, or at least very difficult, for the patient to abduct the eye in the horizontal plane, it was noted in several instances (Cases 10, 41, 43, 46, 49, 51, 52) that he could abduct it to a notably greater extent when it was directed up or when it was directed down. This fact is significant as indicating the part taken by the superior and inferior obliques in performing abduction—*i. e.*, although the externus is completely inert, the inferior oblique will abduct the eye somewhat, particularly when the eye is elevated, and the superior oblique will abduct it when it is depressed. If the external rectus retain some power so that it will abduct the eye moderately in the horizontal plane, the superior and inferior obliques will be still better able to reinforce it, and in such a case the power of outward movement in the upper and lower fields may be complete. This was seen in Case 11.

It is further to be noted that in spite of the completeness of paralysis of abduction that obtains in most cases, there is rarely, if ever, any contracture of the internus.

(*b*) *Restriction of Adduction.*—Out of 49 cases, adduction was normal in only 2, was diminished slightly in 2, diminished more or less considerably in 37, and absent or practically absent in 8. Moreover, as Kunn pointed out, even when the eye can be adducted pretty far, it cannot maintain adduction well nor keep up fixation when adducted.

(*c*) *Oblique Movements Upward or Downward.*—In 31 cases at least, oblique movements were noted in the affected eye. In 24 the eye when it was adducted moved up and in, in 3 it moved down and in, and in 4 it moved up and in when the eyes were directed somewhat up, and down and in when the eyes were directed downward. The oblique movement was absent in at least 3 cases (45, 49, 53).

This peculiar oblique movement of the eyes may be observed in certain cases of acquired paralysis. It is then usually the expression of the secondary deviation that occurs in the non-paretic eye when the paralyzed eye is used for fixing.

(*d*) *Torsion Movements.*—In 5 cases, when the affected eye was carried in, or up and in, its vertical meridian rotated strongly outward (spasmodic action of inferior oblique). In one case (Case 44), when the attempt was made at adduction the eye went up and rotated inward (spasmodic action of the superior rectus). In Cases 10, 21, and 34 torsion movements, indicating probably spasmodic action of the obliques, took place when attempts were made to abduct the eye.

(*e*) *Retraction Movements.*—Retraction movements were noted as absent in 2 cases (49, 51), very slight in 3, slight in 6,* and more or less well-marked in 32. It may be present, as in Cases 14 and 16, when there is no adduction at all, but the patient simply makes an effort to adduct.

When present, the amount of the retraction varied from 1 to 10*mm.* To determine the amount, it is a good plan, as Weeks suggests, to put a spectacle frame containing a diaphragm on the patient and measure the distance between the diaphragm and the eyeball when the eye is turned in various positions.

Sometimes there is an appearance of retraction when no retraction really exists. Thus, the mere closure of the palpebral fissure, which occurs when the affected eye is adducted, makes the eye look as if it had receded. Again, if we look at the eye from the side and the eye turns inward, it will seem to recede, because the cornea which before was

* In one of these (Case 43) perhaps absent as the only evidence of its presence was the contraction of the palpebral fissure.

projecting, and therefore nearer our plane of measurement, is now turned out of the way. To avoid this error the measurement from the diaphragm in the spectacle frame should be taken to the sclera at the edge of the cornea and not to the cornea itself.

In the same case the amount of retraction may vary greatly from time to time (Case 46).

In at least 2 cases (33, 38), in which retraction was produced by voluntary adduction of the eye, it could not be produced when the eye was drawn inward with forceps.

Not only is there recession of the affected eye when adducted, but it may be sunken when the eyes are looking straight ahead. This was noted in 14 cases, although in 5 the enophthalmus was but slight. In one (Case 41) it was extreme. In 3 cases (52, 53, 54) there was no enophthalmus in the primary position.

It must be further noted that, although very rarely, retraction movements are found in other conditions besides the one here described. Thus, it was present in a case noted by Varese,[34] in which there was absolute paralysis of adduction and but slight restriction of the other movements of the eye, yet, whenever the attempt was made to adduct the eye it was retracted strongly. This case was not unlike Case 54 and may after all have to be classed with our cases. Perhaps also to be classed with them, although this seems doubtful, is a case seen by De Schweinitz[35] in which there was an ordinary convergent squint with only slight limitation of outward movement, but in which there were decided retraction movements with narrowing of the palpebral fissure.

Nor is the condition always congenital. In a case reported by Koerber[36] there was retraction in an atrophic stump whenever an attempt was made to move the eyeball upward. Here the retraction was doubtless due, as Koerber thinks, to the presence of cicatricial bands.

(*f*) *Protraction in Abduction.*—In nine cases it was noted that the affected eye protruded somewhat when abducted. In two of these cases this protraction was very slight. In two cases (52, 53) it was not present.

(*g*) *Narrowing of the Palpebral Fissure.*—Closure of the palpebral fissure when the affected eye was adducted was noted as present in 40 of the cases and as absent in 2. In three of the cases in which it was present it was but slight. It seems a significant fact that it was present in one case (Case 13) at least, when, although adduction itself was impossible, yet contraction of the lids occurred whenever the attempt at adduction was made.

There may be some contraction of the lids even in the primary position. This was so in at least 9 cases. In 2 others the palpebral apertures were alike in the two eyes, and in one case (Case 7) the affected eye was wider open than the other.

In at least 4 cases narrowing of the palpebral fissure was observed in both the affected and the sound eye.

When the eye is abducted the *palpebral fissure often dilates* somewhat. This was noted in fourteen cases, but was not present in Case 53.

This peculiar contraction of the palpebral fissure during associated lateral movements of the eyes occurs in other conditions as well. A collection of such cases with extensive bibliography is given by Wilbrand and Saenger.[22] See also Friedenwald.[6] In conditions except that here described the contraction usually takes place when the eye is abducted. I myself noted one such case in which there was a congenital paralysis of the right inferior oblique, and in which, when the eyes were directed to the right, the right palpebral fissure was *6mm* in width, but when directed to the left was *13mm.*

The narrowing of the palpebral fissure, it must be noted, is evidently not a ptosis but due to *contraction of the orbicularis*, the closure being effected as much by an ascent of the lower lid as by a descent of the upper.

(*h*) *Insufficiency of Convergence.*—In 20 of the cases in which the power of convergence was examined, it was normal or but slightly subnormal in 4, decidedly subnormal or paretic in 7, and nearly or quite absent in 4. The ability to perform convergence, however, appears to depend very much upon how the eyes are directed. If directed away

from the side of the insufficient internus they may converge quite well.

The objective symptoms just described constitute the characteristic features of the syndrome. Other features of more or less significance are the following:

(*i*) *Restriction of Passive Movement.*—In most of the cases in which traction with forceps has been tried, it has been found that there is more or less restriction of passive movement, either outward (4 cases) or inward (2 cases). Such restriction, of course, indicates the existence of an actual obstacle, probably an inelastic band, preventing the movement in a given direction. In one case there was very slight resistance to traction either out or in, and in Case 38 the eye could be moved in either direction, but when released flew back to its original position (indicating probably the presence of a more or less elastic band, opposed to the movement).

(*j*) *Deviation in the Primary Position.*—In the primary position there may be orthophoria (noted in 6 cases), divergence (10 cases), or convergence (18 cases). If there is convergence (esophoria or convergent squint) in the primary position, the eyes will be in equilibrium or there will be orthophoria, when the gaze is directed toward the side of the unaffected eye. If there is exophoria or divergent squint in the primary position, the eyes will have to be turned somewhat to the side of the affected eye before equilibrium is attained. In any event, the range through which equilibrium is maintained is usually a very narrow one, the condition changing quickly into one of convergent squint when the eyes are turned in one direction and into divergent squint when the eyes are turned in the opposite direction.

In a number of cases there is marked hyperphoria or vertical squint in the primary position.

(*k*) *Secondary Deviation of the Sound Eye.*—When the affected eye is made to fix, and the sound eye is covered, the latter usually shows a pronounced secondary deviation (so in 13 of the cases). In 8 of these it is expressly stated that the secondary exceeded the primary deviation, just as

it does in ordinary paralyses. In two cases the primary seemed to equal the secondary deviation, and in one case (Case 24) there was no secondary deviation at all.

(*l*) *Position of the Head.*—In many cases the patient carries the head to one side either to avoid diplopia or possibly to avoid the tension produced on the eye when it was not in the position of equilibrium. When there is a tendency to convergence in the primary position, he will, of course, turn the head toward the inactive externus; if there is a tendency to divergence, he will turn the head the other way.

(*m*) *False Projection.*—False projection appears to be an infrequent and little-marked symptom in this condition.

(*n*) *Nystagmus and Pseudo-nystagmus.*—True nystagmus and slow nystagmoid twitchings may occur in these cases particularly when the eyes are carried toward the limits of their movement.

(*o*) *Relation to Ametropia.*—Most of the cases are hypermetropic, but few extremely so. Nor does there seem to be any undue number of cases of high astigmatism or marked anisometropia.

(*p*) *Frequency in Women.*—Out of 51 cases in which the sex was noted, 31 were women. This preponderance is the more striking since the other congenital motor anomalies are more frequent in males. Thus in Kunn's list, if we except the cases of the anomaly now under consideration, 38 were males and 27 females.

(*q*) *Frequency in the Left Eye.*—Out of 54 cases, the left eye was affected in 38, the right in 11, while 5 were bilateral. In one of the bilateral cases (No. 31), the affection was almost exclusively left-eyed; and in 3 of the left-eyed cases (13, 51, 53), there were evidences of very slight restriction in the right eye.

The comparative infrequency of the bilateral cases is surprising, since other congenital motor anomalies are as a rule bilateral. Thus, excluding cases of the anomaly now under consideration, Kunn's list of congenital defects showed 4 right-sided, 12 left-sided, and 50 bilateral.

That in the unilateral cases the left eye is more prone to be affected than the right, agrees with what we find in con-

genital anomalies in general (see Kunn's statistics above). Possibly analogous is the fact that in unilateral reflex iridoplegia the left eye is far more often affected than the right.

(*r*) *Absence of Involvement of Pupil or Ciliary Muscle.*—In none of these cases is there noted any impairment of accommodation or any derangement of the pupil. Of course, in those cases in which the convergence is weak or abolished the convergence reaction of the pupil will be absent, just as it is in any convergence insufficiency when the eyes are directed at some object within the convergence near-point.

SUBJECTIVE SYMPTOMS.

The subjective symptoms are not very marked. They are:

(*a*) *Imperfect Vision.*—In some, but by no means all of the cases, the affected eye was more or less amblyopic. In 16 the affected eye had normal vision, in 7 the vision was $\frac{20}{40}$ or better, and in 11 less than $\frac{20}{40}$. The poor vision in some cases could be attributed to anisometropia, high hypermetropia or astigmatism, or marked squint.

(*b*) *Asthenopia, headache, and a sense of more or less strain* when the eyes are used, or of tension when they are moved, are also sometimes complained of, and, in some cases at least, are evidently due to the abnormal condition of the eye muscles (see Case 10).

(*c*) *Diplopia.*—Spontaneous diplopia is sometimes present (in at least eight of the cases),* and is occasionally troublesome. Sometimes the patient himself observes that diplopia occurs only when he turns his head in a certain direction (see Cases 41, 50, 54).

If diplopia is not present spontaneously it can almost always be elicited by tests. In the cases that came under my observation, the field of single vision was evidently very narrow (often only a few degrees). When we consider how comparatively good the action of the internus apparently

* It was doubtless present in others, especially of the younger patients, from whom sufficient data were not or could not be elicited.

is, this seems rather surprising. In cases like these, when the abducens is completely powerless we should expect to find, as we do, an homonymous diplopia occupying almost the entire half of the field of vision; but it is not so obvious why, with a comparatively good internus, we should have almost all the rest of the field occupied by a crossed diplopia and but a narrow strip, therefore, in which true single vision obtains. This fact and the occurrence of an excessive secondary deviation of the other eye when the affected eye fixed an object toward its inner side, indicated that the internus, however effective apparently, was at least relatively weak.

In the area within which the patient sees single, he has true stereoscopic vision, as shown by Hering's test or by the amblyoscope.

(*d*) *Vertigo.*—This seems rare. In Case 10 it may have been of aural origin.

EXPLANATIONS OFFERED TO ACCOUNT FOR THE PHENOMENA.

Various theories have been advanced to account for this singular combination of symptoms. Such theories must explain why, in a given case, we have (*a*) the absence of abduction, (*b*) the restriction of adduction, (*c*) the retraction movements of the eye, (*d*) the oblique movements observed in adduction, (*e*) the peculiar lid movement observed in adduction, and (*f*) the deficiency of convergence. We may add that, whatever the causal condition may be, it must surely be peripheral in site. We cannot imagine any nuclear or neural lesion that would produce all the phenomena above given, nor one that could produce but a portion of them, and yet invariably leave the interior muscles of the eye exempt.

(*a*) *The absence of abduction* in these cases is most probably accounted for by the fact that the external rectus is absent (as in Case 22), or replaced by an elastic or inelastic connective-tissue cord, as was found by dissection to be the condition present in Cases 26, 29, 33, 34, and 36.

The fact that, in spite of this complete absence of abduction, there is yet no contracture of the internus does not seem astonishing, since secondary contracture is usually* absent in congenital paralyses.

(*b*) *Restriction of adduction* may be ascribed to two causes. First, the internus may be normal and normally inserted, but its contraction may be opposed by a more or less inextensible cord replacing the externus. This condition seems to have obtained actually in some of the cases in which the tendon has been exposed by operation, notably in Cases 26, 29, 33, 34, and 36. It may reasonably be inferred to exist in a given case if, on making passive traction with the forceps, we find that there is a marked obstacle to the movement of adduction, the eye rotating in with difficulty or imperfectly (Axenfeld and Schürenberg).

Second, the internus may be abnormally inserted, especially may be inserted too far back. This condition also has been found to exist anatomically, as in Case 36. It may be inferred to exist in any case if on traction with forceps the eye can be adducted fully and fails to retract.

One point must be considered in trying to account for this defect of inward movement. This defect, apparently slight if we consider the movement of the affected eye alone, is really considerable if we consider the movement of the two eyes together. Thus, even though the internus may carry the eye inward until the cornea nearly reaches the caruncle, there may yet be crossed diplopia over the entire inner half of the field of fixation, showing that even in the primary position the affected eye begins to lag behind its fellow. Again, the presence of an excessive secondary deviation of the sound eye shows that, as compared with its fellow, the movement of the affected eye is considerably hampered in making even the beginning of an inward rotation. This, in itself, would indicate that the cause of the defective movement inward is to be found rather in a mechanical obstacle than in an impairment of nerve energy.

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* Not, however, invariably. See Graefe.[4]

(*c*) *To explain the retraction movements* of the eye no less than five theories have been advanced.

Heuck[3] supposed that the tendon of the internus was inserted too far back, so that it acted not only to pull the eye inward but also backward. In his case and also in one observed by Evans (Case 36), this anatomical anomaly was found to be actually present.

Bahr[11] found in one case that the internal rectus had a second slip inserted far back and acting as a retractor, while the main body of the muscle acted as an adductor. Axenfeld and Schürenberg[25] believed that the same anomaly was present in at least one of their cases (Case 33), since forced traction with forceps failed to produce the retraction and tenotomy of the internus did not abolish it. Knapp's case (Case 30) also seemed to present something of the same sort. Treacher Collins[15] supposed that not only was the tendon inserted too far back, but that there was a deficiency of the check ligaments, so that the natural tendency of the eye to recede was unopposed.

Türk's theory, adopted by Wolff,[16] is that the retraction is due simply to the inextensibility of the external rectus. Under ordinary circumstances, as the internus contracts the externus elongates, so that the eye simply rotates about its centre. On the present hypothesis the externus fails to elongate and the internus, therefore, can contract only in case the eyeball recedes.

This explanation doubtless holds for many of the cases, particularly those in which anatomical examination has shown the insertion of the internus to be normal. This also accounts well for the impairment of rotation inward which these cases show. It seems scarcely to account for the retraction observed in cases where there is no power of adduction at all (see Cases 13, 14, 16, 22, 27, 38, 44, also the case of Varese already cited), nor for the cases in which forced adduction by forceps caused no retraction (Cases 33, 38).

Parker,[9] Peschel,[20] and Schapringer think that retraction is caused by the superior and inferior recti. In those cases where the action of the internus is ineffective, Parker sup-

poses that the superior and inferior recti, acting vicariously as adductors, contract very strongly, and in doing so pull the eye back into the orbit. If this hypothesis be true, we must suppose that the two obliques, which would oppose this retraction, are at the same time relaxed. This Peschel admits and further believes—as Spuler[20] had done before him—that the propulsion of the eye, observed when it is rotated outward, is due to the protracting action of the obliques, which in this situation act very strongly as abductors in place of the ineffective externus.

This hypothesis, so far at least as relates to the retraction, seems to be open to serious objection, as there is no reason for believing that the obliques do relax when the eye is adducted; on the contrary, in these cases they seem to act very strongly. To this point we shall return later.

From the diversity of pathological conditions found, and particularly from the great variation shown in the amount of retraction in cases apparently quite similar, it is evident that the cause of the retraction is not the same in all cases. Indeed when the retraction is very marked it is probable that it may be due to several causes combined.

(*d*) To account for the *oblique movements of the eye*, Wolff[18] suggests the following hypothesis:

"As the eyeball recedes into the orbit it displaces the orbital contents, but the optic nerve, having a firm consistency, offers a certain amount of resistance to the backward movement of the eyeball at its point of attachment. Unless this resistance is made just in the plane of the retraction, the effect must be to rotate the cornea either upwards or downwards: upwards, if the point of resistance lies below the point of retraction; downwards, if it lies above."

In answer to this I have elsewhere said[19]:

"The resistance offered by a flexible body like the optic nerve must be slight indeed, and could scarcely be constant in character and direction. The deviation due to it, therefore, would be irregular and subject to sudden variations, and not marked by the uniform steady increase in the upper field, and the uniform steady decrease in the lower field shown in the present case.

"The vertical deflection might be ascribed to an anomalous insertion of the internus, causing it to act partly as an elevator; but a similar objection to that made against Wolff's hypothesis applies here—namely, that a deviation due to this cause would not be essentially greater when the eyes were directed up than when they were directed down.

"Furthermore, neither theory accounts at all for the singular fact that the left eye, in spite of the almost complete inaction of its externus, diverges markedly and progressively as the eyes are elevated, and when elevated can be abducted to quite a considerable degree.*

"On the other hand, all the conditions are explained upon the hypothesis of an *excessive spasmodic contraction of the inferior oblique*. Such a contraction would tend to carry the eye upward, and the more so in proportion as the eye is turned inward. The ability of the inferior oblique to carry the eye upward, moreover, would increase steadily in the upper field of fixation and diminish steadily in the lower field. Again, when the eye was carried upward, and especially when it was carried upward and outward, the abducting action of the inferior oblique would come into play, and if excessive would cause the eye to diverge in spite of the co-existing paralysis of the externus. Furthermore, in upward, and especially in upward and outward directions of the gaze, the abducting action of the inferior oblique, if excessively exerted, would enable the eye, as in this case, to move outward moderately, even in default of any action of the externus.

"The character of the diplopia, and the way in which it increases and decreases, as also the manner in which the field of fixation is restricted, are strictly in accord with this hypothesis.

"The fact that the diplopia and deviation varied in amount from time to time, while always preserving the same character, lends probability to the assumption of its spasmodic origin.

"It may be added that A. Graefe[1] has cited an instance of a complete paralysis of the externus, in which the obliques

* A similar relation obtained in Cases 41, 43, 46, 49, 51, 52.

acting alone were able to produce a moderate amount of abduction of the eye when the latter was directed up and down, but not, of course, when directed horizontally. In a case of incomplete paralysis of the externus, in which the eye could be abducted somewhat while still in the primary position, this compensatory action of the obliques would come much more markedly into play, since the abducting power of the obliques increases with the degree of abduction of the eye. . . .

"The overaction of the obliques in the cases cited is probably *compensatory in character—i. e.*, the abducting action of the obliques is called into play to an excessive degree to replace, as well as may be, the defective abducting action of the externus."

To this argument it may be added that the torsion movements observed in some of the cases (Cases 2, 3, 10, 21, 25, 34, 43, 53) were such as to indicate spasm of the obliques. In one instance (Case 44) the character of the torsion indicated that the straight up-pull here was due to a spasm of the superior rectus.

This belief that the oblique movements are due to spasmodic action of the inferior or superior oblique, probably often combined with spasm of the superior or inferior rectus, has been confirmed in my mind by the observation of a number of cases, not only of the anomaly we are now considering, but also of cases of an entirely different sort in which the same oblique movement occurred and in which it was undoubtedly due to muscular spasm. Thus it would have been impossible to account, upon any hypothesis of anomalous insertion or pressure of an unyielding optic nerve, or indeed any mechanical explanation whatever, for the following case in which the *oblique movement in one eye was relieved by tenotomy of a muscle of the other.*

R. B., a boy of eight, whenever he looked to the right had always had marked upward deviation of the left eye. In the primary position, left hyperphoria of 6° to 10°, increasing when he looked up and to the right to something like 25°. When he looks to the right, the left eye shoots obliquely upward, particularly if the eye is elevated slightly above the horizontal plane.

In looking down and to the right, the right eye seems to go down excessively. Vertical diplopia in the whole right half of the field of fixation. In monocular vision, no special restriction of the movements of either eye in any direction.

Complete tenotomy of the right inferior rectus, producing some over-correction. Now, when he looks up and to the right, the left eye no longer flies up as before.

Nor would the hypothesis of a faulty insertion or of an unyielding optic nerve account for Cases 6, 32, 39, 51, in which the affected eye went up and in when it was directed slightly above the horizontal plane, and down and in when it was directed slightly below the line. In these cases there was evidently a spasmodic action of both the superior and the inferior oblique.

(*e*) No adequate explanation for the peculiar *closure of the palpebral fissure* when the affected eye is directed inward has been offered. It cannot be due to the enophthalmus or sinking of the eye, since it occurs in cases in which retraction is absent, or nearly so (see Cases 37, 49, 51), and on the other hand may be absent when the enophthalmus is extreme (see Case 41). It is probably, as Parker suggests,* an example of some peculiar associated movement produced by synergic action of the facial and third nerve.

(*f*) The *insufficiency of convergence*, which is sometimes present, sometimes absent, seems to be due simply to the mechanical hampering of the action of the affected internus. The patient, finding it difficult to make the affected eye move inward as fast as its fellow, gives up the attempt at converging and lets the faulty eye diverge. When, however, the eyes are so diverted as to impose little tension on the inefficient internus, the act of convergence may be performed in almost normal fashion. This would not be the case if the restriction in convergence was due to central causes, *i. e.*, was a true paresis.

Thus in Case 51, when the eyes were directed straight forward the convergence near-point was at 75*cm*; when the eyes were directed a little to the left (limitation of rotation outward of L eye) it was at 7*cm*. It might be argued that here there was no

true convergence-movement, but really a parallel movement of both eyes to the left, the two eyes converging more and more in doing this, simply because the outward movement of the L eye was arrested. But this view was negatived by the fact that, when the eyes were thus directed to the left and an object in line with the L eye was brought straight in toward the latter, not only did the R eye turn to the left to follow the object, but both pupils contracted, showing that the movement of the R eye was really one of convergence. Such a contraction did not take place when the R was following a distant object that was moved from right to left.

TREATMENT.

In view of the pathological condition which probably underlies most of these cases, advancement by increasing the tension, and hence the retraction, would do more harm than good. So it proved in Case 5.

In cases where there is marked inward squint, tenotomy of the internus may help (see Cases 29, 30).

In the opposite sort of case, where the eye tends rather to diverge and is hampered by an inextensible band replacing the externus, an operation for lengthening this band (after the fashion adopted by English operators) might be serviceable. In Case 36,* however, it did no permanent good; nor did tenotomy of the externus in Case 10. Otherwise the proper operation would be that performed in Case 51, viz., tenotomy of the externus of the other eye.

In general an operation is not required, and is to be avoided when possible.

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* The case here described is Case 46, but the discussion refers to Case 45.

STUDIES IN THE LIGHT SENSE.

By PERCIVAL J. HAY, M.D. (Edin.),

EYE HOSPITAL, BIRMINGHAM, ENGLAND.

(*With two figures on Text-Plate IV.*)

"OBWOHL man schon seit langer Zeit verschiedene Wege kennt, auf welchen man zu einem numerischen Ausdruck, sowohl für den Lichtsinn, als für den Farbensinn gelangen kann, so fehlt doch noch viel daran, dass die ebengenannten beiden Sinnesenergien so oft und so genau bestimmt würden, als der Formsinn."

Though more than twenty years have passed since these remarks were made, Ole Bull[1] would have been perfectly justified in using similar words to-day, if he had purposed publishing a new series of studies in the light sense. On the other hand, the color sense has attracted a good deal of attention both with regard to physiology as well as pathology.

That the former has not been examined more frequently may be said to be due chiefly to the fact that it is not possible to do so with the same comfort and ease as is the case in the study of the form sense, and that at least up to the present there has not been the same degree of fascination about it that belongs to the color sense.

The first difficulty I have striven to minimize by designing a new photometer, and with regard to the second, it may be expected that the subject will gain in interest, both on its own merits and in the light of its relations to the color sense.

[1] Ole B. Bull, "Studien über den Lichtsinn und Farbensinn." *Graefe's Archiv f. Ophthalmologie*, xxvii., 1, p. 54.

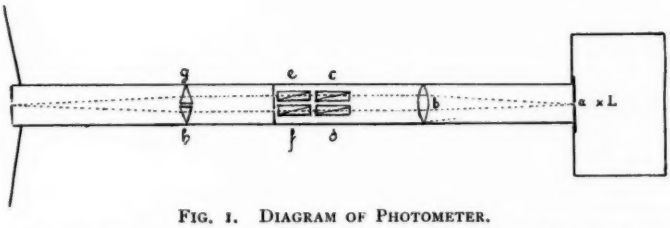

FIG. 1. DIAGRAM OF PHOTOMETER.

L, Standard candle; *a*, diaphragm; *b*, lens; *c* and *d*, first pair of Nicol prisms; *e* and *f*, second pair of Nicol prisms; *g* and *h*, ordinary prisms.

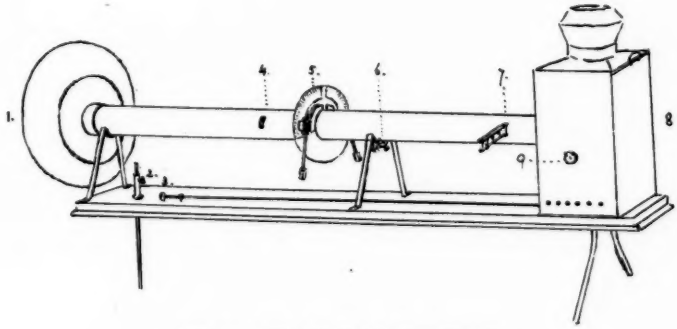

FIG. 2. THE AUTHOR'S PHOTOMETER.

1. Shield; 2, adjustment for raising and lowering apparatus; 3, screw for horizontal adjustment of candle; 4, adjustment for ordinary prisms; 5, scales with verniers and tangent screws for regulating Nicol prisms; 6, centring screws; 7, color slide; 8, light-tight case; 9, screw for vertical adjustment of candle.

PHYSIOLOGY OF THE LIGHT SENSE.

Before passing on to the subject proper of these pages, the clinical investigation, a few remarks may be permitted with reference to the physiology of the light sense.

Since the classical experiments of Bjerrum[1] the examination of the sensibility of the retina to light has proceeded upon two lines: the one to arrive at the light minimum, M; the other to determine the light difference, D. By *light minimum* is meant the minimal stimulus capable of being perceived, the threshold of sensibility. In the use of colorless light there is only one such threshold; colored light, however, at low intensities, appears colorless, and therefore one has to distinguish between the point at which the colored light is seen as light only: the absolute threshold; and the point at which its color can be determined: the specific or chromatic threshold. The interval is called the photochromatic interval, and is greatest for green, nearly absent for red. The fact that the interval between the absolute and chromatic thresholds is greatest for green stands in relation to Purkinje's phenomenon. Purkinje found that with decreasing intensity of the spectrum the short wave-end became relatively the brighter; and when a colorless spectrum is reached the brightest part is then seen to be in the position corresponding to green. Under these conditions the light sense is most sensitive to waves corresponding to E; at ordinary luminosities, however, waves corresponding to D appear to make a greater impression. The maximum of sensation is reached with a lower intensity, in light of short wave-lengths, than in that of long wave-lengths. Blue does not retain its specific tone as long as red. If the intensity is increased beyond ordinary limits the whole spectrum becomes colorless. Thus there is an intimate relation between the light sense and color sense, the former being alone affected in light of low and high intensities, while medium intensities affect both.

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[1] Jannik Bjerrum, "Untersuchungen über den Lichtsinn und Raumsinn bei verschiedenen Augenkrankheiten." *Graefe's Archiv f. Ophthalmologie*, xxx., 2, p. 201.

By *light difference* is meant the minimal difference capable of being perceived, the threshold of discrimination. For colorless light there is only one, but colored light may be examined as regards tone, brightness, and saturation. Aubert[1] states that as the illumination diminishes the threshold of discrimination is increased. Kräpelin[2] and Schirmer,[3] on the other hand, found that the threshold of discrimination is constant when due attention is paid to adaptation.

The light difference is stated to be $\frac{1}{186}$ (Aubert), $\frac{1}{217}$ (Schirmer), $\frac{1}{240}$ (Ole Bull). It appears to me to be still less.

Whether the light sense is equally good all over the retina seems to be still a moot point. According to the latest experiments (Krienes[4]) the fovea is supposed to be night blind compared to the periphery of the retina.

Henry[5] believes that the light minimum tends to increase after the age of thirty.

PATHOLOGY OF THE LIGHT SENSE.

The first to study the light sense to any extent in cases of disease was Förster.[6] His investigations were directed towards the determination of the light minimum, and for this purpose an apparatus was used, designed by himself, and known as Förster's photometer. It was called a "Lichtsinnmesser" originally, a more accurate term. This still seems to be the instrument chiefly used where the light minimum is to be estimated. Briefly it consists of a box, into which the observer looks. On the wall facing him there are white letters upon a dark background, which may be illuminated more or less by means of a diaphragm regulating the amount of light from a standard candle.

The apparatus suffers from more defects than one, but

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[1] Aubert, *Physiologie der Netzhaut*, p. 52.
[2] Kräpelin, *Handbuch der physiol. Optik*, 1867, p. 315.
[3] Schirmer, *Phil. Stud.*, ii., p. 316.
[4] Hans Krienes, "Der Lichtsinn bei Krankheiten der Retina, Choroidea und des Sehnerven," *Archiv f. Ophthalmologie*, xxxiii.
[5] R. Wallace Henry, *Ophthalmic Review*, vol. xv., p. 33.
[6] Förster, "Lichtsinn bei Krankheiten d. Choroidea und Retina." *Zehender's klinische Monatsblätter f. Augenheilkunde*, 1871.

still some interesting results were obtained. Assuming the standard of the normal light minimum to be $\frac{1}{1}$, then Förster found it to vary:

from $\frac{1}{1}$ to $\frac{1}{4}$ in neuritis optica,
" $\frac{1}{12}$ " retinitis apoplectica,
" $\frac{1}{6}$ " apoplexia retinæ,
$\frac{1}{1}$ " $\frac{1}{2}$ " retinitis albuminurica,
$\frac{1}{1}$ " $\frac{1}{6}$ " atrophia nervi optici (white),
" $\frac{1}{6}$ " hemiopia ex apoplexia cerebri,
$\frac{1}{1}$ " amblyopia ex abusu nicotianæ et spirituosorum,
$\frac{1}{60}$ to $\frac{1}{250}$ " chorioideitis disseminata,
$\frac{1}{250}$ " $\frac{1}{750}$ " retinitis pigmentosa,
$\frac{1}{500}$ " $\frac{1}{750}$ " sublatio retinæ,
$\frac{1}{64}$ " $\frac{1}{750}$ " chorioideitis syphilitica,
$\frac{1}{300}$ " $\frac{1}{750}$ " atrophia nervi optici (yellow, secondary to syphilitic choroiditis).

Thus two great groups stood out in contrast, and, as Förster pointed out, the first consisted of diseases primarily involving the nervous elements, the second of those in which the choroid and external layers of the retina were implicated, and it was in the latter that the light sense was found much reduced, or, in other words, the light minimum much increased.

A few years later, Bjerrum went a step farther. Apparently up to that time one had been satisfied with ascertaining either the light minimum or the light difference, and had assumed that a diminution in the one meant a proportionate diminution in the other. Bjerrum, however, argued: "Man kann sich die Reizschwelle des Lichtsinnes vergrössert denken, ohne dass die Unterschiedsempfindlichkeit für einigermassen bedeutende Helligkeiten verändert ist,—und man kann sich diese letztere verkleinert denken ohne Veränderung der Reizschwelle."

In order to determine at the same time the relationship between visual acuity and light sense, the experiments were carried out with Snellen's test-types, first with good daylight and then with varying degrees of illumination. The

examination was repeated with similar test-types of four different shades of gray. The patient was then allowed ten minutes to accustom himself to daylight again, and then he was examined with Mason's disc.

It was found that the light minimum may be considerably increased without any affection of the light difference for greater intensities, while, on the other hand, the reverse is also true: the light difference may be much affected without any increase in the light minimum.

Patients with choroido-retinitis showed a tendency to an increase in the light minimum, whereas those suffering from optic atrophy showed an increase in the light difference.

Cases of tobacco amblyopia presented an increase in the light difference.

The visual acuity obtained with the gray letters was found to be a more delicate test for differences in illumination than that obtained with black letters. For this reason, hemeralopia was detected sooner with the pale letters than with the black letters when the illumination was reduced.

At the Eighth International Medical Congress at Copenhagen Samelsohn read a paper on the light sense, in which he communicated the results of a long series of examinations with Mason's disc.

He ascertained that affections of a purely optical nature involving the cornea, lens, or vitreous have no influence upon the light difference, but that refractive errors are not uncommonly associated with an increase in it, whether the error is corrected or not.

Low degrees of myopia do not seem to show any affection of D (light difference), whereas in errors of more than three diopters two thirds of the cases are affected.

Eyes with a high degree of hypermetropia are in a similar position, but not in such a marked degree.

Monocular strabismus shows an increase, as a rule, in the deviating eye. (Bjerrum did not detect any.)

All intraocular diseases of the eyes seemed to be associated with an increase of D, optic atrophy most and choroido-retinitis least. This is in accordance with the results of Bjerrum.

In toxic amblyopia, D was normal if there was no absolute scotoma present, otherwise it was more or less increased.

In glaucoma both the light minimum and the light difference were increased, though the latter was not as marked as in optic atrophy.

Further investigations were made by Henry,[1] who used a photometer in which opal discs were placed between the observer and a standard candle. He found in this way that the light minimum was markedly increased in diseases of the retina, but not so much in choroidal disease.

Further studies seemed to me to demand an apparatus more conveniently arranged, and yet delicate, besides being so constructed that it owed its properties to simple physical laws, so that an exact duplicate could be built. It seemed also desirable to be able to test the light minimum and the light difference, both with the same instrument and under the same conditions.

It occurred to me that the construction of such an instrument should be feasible, and I spent many months in trying to find a satisfactory solution of the problem. It was found impossible to vary the intensity of the source of light itself in a practical way, and equally so to obstruct the path of light by means of standard opacities, either fluid or solid. It may perhaps be mentioned that opal discs such as are used in Henry's instrument are only approximately standardized.

In the instrument[2] described below and designed by myself, the rays of light are polarized, and their further course towards the observer is more or less permitted by means of an analyzer. Thus a very delicate instrument is obtained, in which the range of the light sense is divided into nine hundred parts, as will be explained. It can be rendered still more delicate by means of a device described below.

The source of light is the standard candle L (see Scheme and Sketch, at the end of the article). The distance between it and the eye of the observer is one metre. A luminous point is obtained by means of a diaphragm (*a*), with an aperture of

[1] R. Wallace Henry, *Ophthalmic Review*, vol. xv., p. 33.
[2] Manufactured by Messrs. Bailey & Son, Birmingham.

1*mm* in diameter. The rays diverging from this point are rendered parallel by a lens (*b*), so placed that its focus coincides with the luminous point. They then pass through a Nicol prism (*c*), and in this way become polarized. For purposes of examining the light difference, two Nicol prisms are placed side by side in such a way as to receive the same amount of light. The polarized light leaving the prisms *c* and *d* then falls upon a second pair of Nicol prisms *e* and *f*. When the latter have the same position as regards plane of polarization as the former, they allow the light to pass through; if, however, the planes of polarization are at right angles to each other, no light is transmitted. In the intermediate positions a certain amount is allowed to pass, which varies with the angle obtaining between the planes of polarization. Thus all degrees, from complete darkness to total light, are obtained, and the standard of darkness is not an arbitrary, subjective one, but an absolute one, as we know it is physically impossible for any light to be transmitted. The light leaving the prisms *e* and *f* is deviated towards the aperture in the eye-piece by means of the ordinary prisms *g* and *h*, so that for purposes of comparison both luminous areas can be viewed at the same time. Again the standard of comparison is not a subjective, but an absolute one, since, if the two analyzing prisms are placed at the same angles, the same amount of light is transmitted through each of them. The luminous areas are rendered round by diaphragms placed in front of the Nicol prisms in order to avoid implicating the form sense.

The standard candle is placed in a light-tight box, and can be so raised and lowered, or moved from side to side, as to be exactly opposite the aperture in the diaphragm.

The centre of the tube is adjustable, so that the instrument can be centred in the same way as an Abbé condenser in a microscope.

There are two scales on the apparatus, one for each aperture. Each is divided into 90°. The prisms *e* and *f* have to be turned through a right angle, in order to vary the illumination from total light to complete darkness; the position of the prisms is shown by an indicator

for each scale. If the indicator is standing at 90°, all the light from the candle is passing through (strictly speaking this is not quite correct, but the assumption does not vitiate the results of the examination). If the indicator is standing at zero, no light is passing through. The prisms are turned by means of tangent screws, and the scales are read with the help of a Vernier, the latter dividing each degree into ten parts. The scales are thus divided into nine hundred parts.

If the indicator is standing at zero, no light is passing through the prisms. If the indicator is standing at 2°, 2° of the whole possible 90° of light are passing through. There still remains the test for color-vision. For this purpose a slide (*k*) with colored glasses is interposed between the source of light and the lens *L*.

At the eye-piece there is an arrangement for placing spherical and cylindrical lenses in front of the aperture, if necessary, so that the rays of light can be focussed accurately upon the retina. On the other hand, supposing one wishes to test the general sensitiveness of the retina, this may be done by bringing the rays to a focus in front of the retina by means of a convex lens. By the same means the quantity of light reaching each rod and cone may be reduced, and thus the apparatus rendered still more delicate.

The end of the instrument next to the patient can be raised or lowered to a suitable height.

There is an advantage, which is not to be despised, in having a tube so that the patient can grasp the instrument like a telescope, and in this manner obtain with the help of his muscular sense an idea in which direction to look.

The examination is undertaken in a dark room. The scales are read with the help of a little pocket electric lamp, such as can be obtained for a shilling or two, and any stray light is kept off the patient by a shield.

How to Use the Photometer.

Before examining a patient, the light must be so adjusted that both prisms are illuminated equally. Both prisms are

set at 10°, and then the light can be adjusted rapidly and accurately by vertical and lateral adjustment of the candle.

The patient is then asked to look through the instrument, and is asked to note the four following points:

1. When one light begins to differ from the other in intensity.
2. When the fainter of the two disappears.
3. When it re-appears.
4. When it is equal to the other.

The movement of the prisms is noiseless, so that the patient cannot get any information as to whether their position has been changed or not.

I instituted these four tests, which to my knowledge have not been tried before, because it was noticed (1) that most patients were *slower* in noting a *difference* in the intensities, and more accurate in equalizing them; (2) that they were *slower* in detecting the *re-appearance* of the light than its disappearance. To give an example:

When a patient is going to be examined, the Nicol prisms *e* and *f* are set so that 10° of light are allowed to pass through each of them. Thus the illumination of the two apertures seen in the photometer is equal. Then one of the prisms, say the one on the patient's right-hand side, is so rotated as to diminish the quantity of light passing through it. The patient is watching the two illuminated apertures all the time and says when he notes the right aperture becoming fainter than the left. This may be at a point indicated as 7° and is noted by the surgeon. The prism is then turned farther towards zero (darkness), and the patient sees 6°, 5°, 4°, 3°, 2°, 1°, 0.5°, and in fact he sees the last tenth of a degree and does not say "dark" until the pointer indicates zero. The patient is now told to watch the returning light. The prism, starting from zero, moves to 0.5°, 1°, 1.5°, and it is perhaps only when 2° are indicated that the patient says he notices the first glimpse of light.

By light minimum is meant, where not stated otherwise, the least amount of the *disappearing* light the patient can observe.

For light difference the patient is asked to tell when he thinks both "lights," as the patients call the illuminated areas in the photometer, are equal, and then $\frac{1}{10}°$ is noted below that—*e. g.*, $10 = 9 \therefore D = 10 - 8.9$.

The patient thought the two "lights" equal when the left prism stood at 10° and the right at 9°, therefore they were different when the right one was still at 8.9°.

Ten minutes are allowed for adaptation.

↓ means diminishing light.

↑ means increasing light.

L. M. means left (light) minimum.

R. M. means right (light) minimum.

L. D. means left (light) difference.

R. D. means right (light) difference.

The results obtained in the following pages were noted before any literature had been read on the subject, except Henry's article in the *Ophthalmic Review*. I think I may say they are free from bias.

THE AUTHOR'S INVESTIGATIONS.

The Emmetropic, Myopic, and Hypermetropic Eye.

Patients with emmetropic eyes and those with low degrees of myopia and hypermetropia are able to detect from 0.1° to 0.3° of light, the first nearly always noting 0.1°, the ages of the patients being from ten to thirty. Their light difference has a greater range, varying with the intelligence, education, and powers of observation of the patient. At 10° it may vary from 0.1° to 0.5° (10° is a moderate light intensity).

The following instances may be given:

J. W., age twenty-nine.
R V $\frac{6}{6}$ c^{1} + .50 = $\frac{6}{6}$, R M 0.3, R D 10 − 10.3.
L V $\frac{6}{6}$ c^{1} + .50 = $\frac{6}{6}$, L M 0.3, L D 10 − 10.3.

J. G., age thirty.
R V $\frac{6}{6}$ c^{1} + .75 = $\frac{6}{6}$, R M 0.1, R D 10 − 9.2.
L V $\frac{6}{6}$ c^{1} + 1 = $\frac{6}{6}$, L M 0.1, L D 10 − 9.3.

In patients with high refractive errors the powers for noting differences in illumination especially are much diminished, and sometimes the light minimum is effected. The four cases instanced below show these points well, but any other cases would have demonstrated them in the same way.

Examples of high errors of refraction:

1. Julia W., eight, school.
R V $\frac{6}{36}$ part c` + 7 ⊃ + 1 ax. 80°, R M ↓0.1, ↑1.0; R D 10 — ↑4.6.
L V $\frac{6}{18}$ part c` + 7 ⊃ + 1 ax. 100°, L M 0.1, 1.0; L D 10 — 4.1.

2. Alfred P., thirteen, school.
R V $\frac{6}{18}$ c` + 5.5 ⊃ + 2 ax. 60°, R M ↓0.1, ↑2.8; R D 10—↓5, 10—↑7.4.
L V $\frac{6}{12}$ c` + 4.5 ⊃ + 2 ax. 135°, L M 0.1, 2.0; L D 10 — 7.8, 10 — 7.5.

3. Samuel C., twenty-five, tailor.
R V $\frac{6}{24}$ c` — 6 ⊃ — 1 ax. 180°, R M ↓0.1, ↑2.5; R D 10—↓4.3, 10—↑7.3.
L V $\frac{6}{18}$ c` — 6 ⊃ — 1 ax. 180°, L M 0.1, 2.7; L D 10—4.3, 10—11.6.

4. Samuel H., eighteen, crane-driver.
R V $\frac{6}{12}$ c` — 3 ⊃ — 3.5 ax. 180°, R M ↓1.0, ↑4.0; R D 10 — ↑8.5.
L V $\frac{6}{12}$ c` — 3 ⊃ — 3.5 ax. 180°, L M 1.0, 4.0; L D 10 — 8.4.

Foreign Bodies in the Globe.

The following three patients were examined some time after the removal of the foreign body (steel). They show the effects that vitreous opacities have upon the light sense. These opacities were present to a greater or lesser extent in each case. Fundus normal.

1. William J., twenty-nine, fitter.
R V hand movements, R M 4.0; R D 10 — 10.5.

2. James R., thirty-four, wheelwright.
R V $\frac{6}{18}$, R M 8; R D 10 — 7.7.

3. Walter T., thirty-two, laborer.
R V hand movements, R M 23.7.

In each case the light minimum is considerably increased, whereas the light difference is not affected to the same extent.

As regards the third patient, no estimate of the light difference could be obtained, because he had only a very diffuse impression of light, and could not make out whether only one or both of the lighted areas were shown to him. The opacities in this case were fine and very evenly distributed throughout the vitreous.

Choroiditis and Choroidal Atrophy.

Disseminated choroiditis and syphilitic choroiditis have been studied so carefully, and their main characteristic, the increase of the light minimum, has been so well established, that no further additions in this direction have seemed to me to be necessary.

Other varieties, therefore, were examined, varieties of which there were no records as regards the light sense, and in which the inflammatory condition was localized, and, as far as could be ascertained, not of a syphilitic nature. The results in these cases were not by any means uniform; sometimes the light minimum was more affected than the light difference, sometimes the opposite was the case.

Jane W., seventeen, no occupation, presented a different appearance in each eye. The left eye was affected with typical disseminated choroiditis: L V was $\frac{6}{18}$ c^{l} + 2, L M 6.5, L D 10 — 10.5. It thus confirms previous observations. The right eye showed a localized patch of choroiditis not involving the macula; R V $\frac{6}{12}$ c^{l} + 6 ⊃ + 2 ax. 60°, R M 6.3, R D 10 — 18.5. Thus in this case both M and D were affected, and almost to the same extent, as something must be allowed for the high hypermetropia. It will be noticed that the girl allowed the right light in the photometer to be increased beyond 10.

The next patient offers a contrast. The right eye was healthy, the left one showed a localized patch of choroiditis below and internal to the disc.

Alexander R., thirty-five, railway servant.
R V $\frac{6}{18}$ c^{l} — 1.5 ⊃ — 1.75 ax. 180 = $\frac{6}{6}$, R M 0.1, R D 10 — 9.
The myopia accounts for D.
L V $\frac{6}{36p}$ c^{l} — 1.75 ⊃ — 1 ax. 180 = $\frac{6}{12p}$, L M 0.1, L D 10—15.7.
There is a considerable increase in D.

Elizabeth H., fifty-five, widow.

Choroiditis, chiefly in the left eye, with some vitreous opacities in the latter. The inflammation did not involve the macula. Low hypermetropia.

R V $\frac{6}{18}$, R M 0.1, R D 10 — 11.

L V $\frac{6}{36}$, L M 2.3, L D 10 — 7.4.

Phoebe B., twenty-one, brazier.

Choroiditis close to macula in both eyes; the right with a round area of atrophy of choroid close to macula. Emmetropic.

R V $< \frac{6}{60}$, R M 8.4, R D 10 — 12.

L V $< \frac{6}{60}$, L M 4.8, L D 10 — 8.

Here the light minimum is chiefly affected.

Eleven other cases of a similar nature were examined in the same way; most (six) showed an increase in the light minimum, three an increase about equal as regards the two tests, two an increase in the light difference.

Thus it is difficult to draw any conclusions, but the light minimum seems to be less affected the farther the inflamed area is from the yellow spot.

In none of the cases did the light difference remain unaffected.

Glaucoma.

The cases of glaucoma, subacute and chronic, that were examined were characterized by a slight increase, if any, in the light minimum, whereas there was a considerable increase in the light difference. It is noteworthy that this condition was also found where apparently, as yet, there were no symptoms or signs of glaucoma, but where the patient was undoubtedly suffering from glaucoma in the other eye.

The following is an instance:

Ann P., sixty-seven, widow.

The patient came with an attack of acute glaucoma and a history of chronic glaucoma of some duration in the left eye. She had no perception of light. Iridectomy was performed, but vision did not return.

As soon as the patient was able, the other eye was examined and the following condition found:

R V $\frac{6}{9}$(4 letters); R field full; tension good.

Media clear, no cupping of the disc.

On examining the light sense: R M 1.0, *R D 10 — 16!*

Susan H., fifty-four, gold-polisher.

This patient complained of her sight failing in both eyes and of pain lasting three months; she had photopsia and saw colored rings round lamps, etc. Tension full in the right eye; tension in the left good. The right eye was also affected with a nearly mature cataract.

On examining the light sense, the right eye was found to have no central light perception, and only faint perception of light at the periphery. The left eye:

L V $\frac{6}{12}$ partly c^{1} — 1 sph = $\frac{6}{9}$; L M 0.3, L D *10 —19.7—i. e.*, no affection of the light minimum, but a large increase of the light difference.

Dinah S., seventy, laundress.

This patient presented a contracted field, a deep cup, and she could only count fingers at 3 in. L M 0.5, L D 4.0.

Four other cases presented similar appearances and were tested with similar results.

Optic Atrophy.

The results of the cases examined with regard to light minimum and difference in optic atrophy are largely confirmatory of those obtained by Bjerrum and Samelsohn,—viz., that the light difference is markedly increased, but the light minimum is not very much affected.

In many instances, however, the light minimum is considerably increased, as will be seen from the cases given below.

Joseph L.. thirty-nine, turner.

This was a case of optic atrophy in both eyes.

R V $< \frac{6}{60}$, R M 0.1, R D 10 — 9.5.

L V $< \frac{6}{60}$, *L M 6.0*, L D 20 — 29.

Frank W., thirty-one, ex-soldier.

This patient was suffering from optic atrophy in both eyes, following upon malaria.

R V $< \frac{6}{60}$, *R M 15.5*, R D not obtainable.

L V $< \frac{6}{60}$, *L M 10.6*, L D 20 — 31.8.

William B., thirty-two, carter.

Optic atrophy was present in both eyes.

R V fingers at 70*cm*, R M 1.0, R D 10 — 6.6.

L V fingers at 30*cm*, *L M 6.0*, L D 10 — 20.7.

Tobacco Amblyopia.

Tobacco amblyopia does not seem to be associated with any marked affection of the light sense. Both the light minimum and the light difference are only slightly increased.

To show how far the light sense is affected the two following cases are cited. They are taken from a series of ten similar cases.

Frank H., fifty, porter.

This patient was in the habit of smoking one ounce per diem of "Pioneer" or "Smith's Glasgow Mixture." Central scotoma was present for all colors.

R V $\frac{6}{18}$, R M 0.3, R D 10 — 10.5.

L V $< \frac{6}{60}$, L M 1.0, L D 10 — 8.

James P., thirty-eight, brass-tube drawer.

This patient smoked half an ounce of twist per diem. Central scotoma was present for all colors.

R V $< \frac{6}{60}$, R M 1.5, R D 10 — 9.5.

L V $< \frac{6}{60}$, L V 1.0, L D 10 — 11.4.

Retinitis.

Retinitis Pigmentosa.

That the light minimum is markedly increased was shown by Förster and has been confirmed by subsequent writers. The light difference is also very much increased.

Charles H. C., forty-four, no occupation.

This patient presented typical retinitis pigmentosa with secondary atrophy of the optic nerves. He had lost his perception of light in the right eye. The left one showed:

L M 5.0, L D 10 — 20.

Diabetic Retinitis.

Alfred N., sixty-six, music teacher.

This patient had been suffering from diabetes mellitus for more than twelve months.

The right eye did not show any gross lesion in the fundus, the left one, however, showed extensive retinal hemorrhages with retinitis distributed irregularly over the fundus.

R V $\frac{6}{6}$, R M 0.3, R D 10 — 10.7.

L V $\frac{6}{12}$, L M 0.8, L D 10 — 12.7.

Thus the light sense was only slightly affected, especially the light minimum.

Retinitis Proliferans.

Louisa Y., twenty-eight, no occupation.

Retinitis proliferans was present in the left eye. Both eyes were slightly myopic.

R V fingers at 3 ft.

L V $\frac{6}{60}$ c' — 1 cyl. ax. 90°, L M 8, L D 10 — 15.5.

Here both the light minimum and the light difference were markedly increased.

Albuminuric Retinitis.

James H., forty-five, bricklayer.

Albuminuric retinitis was found in the right eye.

R V $< \frac{6}{60}$, R M 4.8, R D 10 — 14.2.

Jesse W., fifty, laborer.

Albuminuric retinitis was present in the right eye.

R V fingers at *2m*, R M 7.2, R D 10 — 15.5.

It is not easy to draw any conclusions from these cases of retinitis. It may be said, however, that inflammations of the retina do not all affect the light sense to the same extent, and that the deeper the inflammation the greater the deterioration of the light sense.

Summary of the Author's Results.

The results obtained with the new photometer may be summarized as follows:

Refractive errors, if low, do not affect the light sense; if high, tend to increase the light difference.

Vitreous opacities increase both the light minimum and the light difference.

Choroiditis, other than syphilitic and disseminated choroiditis, affects both the light minimum and the light difference. The light minimum is generally more affected than the light difference, but not invariably so. The implication

of the light sense seems to vary in extent according to the position of the lesion. It appears to be more impaired if the lesion is close to the macula.

Glaucoma chiefly increases the light difference. An increase in the light difference may be one of the earliest signs of the disease.

Optic atrophy generally affects the light difference, but there are cases in which the light minimum is very much increased.

Retinitis increases both the light minimum and the light difference. Affections involving the internal layers of the retina more than the external ones do not seem to affect the light sense as much as those situated in the external layers.

In conclusion, I should like to say that the results obtained by me are not meant to be conclusive, but I think they tend to show that the examination of the light sense is important, that both the light minimum and the light difference should be examined in every case, that it is an advantage to be able to test the light minimum and the light difference under the same conditions, and that a delicate instrument is necessary.

THROMBOSIS OF THE CENTRAL VEIN OF THE RETINA IN CHLOROSIS.

By Dr. THEODOR BALLABAN, of Lemberg.

(*With Plate XXIII., Vol. XLI., German Edition.*)[1]

Abridged Translation from the German Edition, June, 1900, by Dr. Matthias Lanckton Foster.

M. G., twenty-six years old, stated that the vision of her right eye had failed for about four months, and now she could scarcely see anything. As a child she had often had pain in her eyes, but never lost her vision. Her general health was poor; her menses were irregular and scanty; she often had palpitation of the heart, dyspnœa, obstipation, dyspepsia, headache, and was nervous and hysterical. There was a case of tuberculosis in her immediate family. Her face was slightly bloated, pale, and yellowish. The conjunctiva and the mucous membrane of the mouth were almost colorless. Physical examination showed no changes in the lungs, anæmic murmur in the heart, and a marked venous hum in the jugular veins. There were no intestinal parasites. Kidneys normal. Examination of the blood showed a deficiency of the red blood corpusclés.

The right eye was externally normal. Pupil reacted to light and accommodation. There were many little opacities in the vitreous. The papilla was very hyperæmic and hazy, so that its lateral margins alone were visible and they not clearly. The retina, especially along the veins, was hazy and of a grayish color. The large veins were three or four times the normal size, and appeared broken in places where they were covered by the opaque retina. In many places the blood columns of the veins

[1] *Erratum.* The volume of the German Edition is marked on the Plate LXI. instead of XLI.

were segmented, while white and red cylinders followed each other in vessels of uniform calibre, plainly showing the presence of a current. No pulsation could be produced in the veins on the papilla by pressure on the eyeball, neither could they be emptied in this way even when the pressure was severe. The arteries were invisible on the papilla, but could be seen only as thin threads in the periphery, although the small papillary vessels were visible. Along the large vessels in the retina were very many large and small hemorrhages, most of them linear. In the region of the macula and between it and the disc, lying mainly downward and outward, were stellate groups of various sizes and extent, in the form of yellowish and white foci of degeneration.

The diagnosis of "thrombosis of the central vein" was based on these circulatory phenomena: The distension of the veins, with diminished size of the arteries; the segmentation of the blood columns in the veins; and the fact that increase of intraocular tension by pressure with the finger upon the eyeball produced neither pulsation nor expulsion of the blood from the veins on the papilla.

TRANSACTIONS OF THE TENTH INTERNATIONAL OPHTHALMOLOGICAL CONGRESS, IN LUCERNE, SEPT. 14 TO 17, 1904.

REPORTED BY DR. W. MERTENS, WIESBADEN, AND DR. K. WESSELY, BERLIN.

Abridged Translation by Dr. MATTHIAS LANCKTON FOSTER, New York.

FIRST SESSION, SEPT. 14, 9 A. M., PROF. KUHNT, KÖNIGSBERG, PRESIDING.

This session was devoted to the discussion of the subject: "The Determination of the Value of an Injured or Destroyed Eye with Reference to the Question of Damages." It was opened with three papers by Messrs. SULZER, AXENFELD, and WÜRDEMANN.

1. A. SULZER (Paris). **The estimation of the value of a lost or injured eye as regards the question of damages.**

SULZER stated that in France the law on the subject gave for partial disability an indemnity of one-half the loss in wages caused by the accident, and for total disability two-thirds of a year's wages. Most countries have laws similar in principle. In view of these laws two questions needed settlement: (*a*) the scientific determination and expression of vision, and (*b*) the relation of the vision required for the earning capacity to the scientific vision.

(*a*) **The measurement of the vision and its uniform expression.**

He approved of the decimal system to express the measurement of the different degrees of vision, but as the difference in the size of the letters which correspond to visions 0.1 and 0.2 is enormous, while that between 0.9 and 1 is slight, he recommended that types be added to correspond to visions of 0.125, 0.15, and

0.25, while 0.7 and 0.9 be dropped. He has also added to the test letters a so-called "lattice test," composed of circular fields crossed by black parallel lines, the breadth of each equal to that of the lines of the corresponding letters, which change their directions at various angles. The patient has to indicate which circles seem to have a homogeneous background and in which the lattice-work can be seen. He claimed that this test will give the true vision whether it agrees with the test letters or not. An additional advantage is that the presence of astigmatism can be recognized and its amount determined by the use of this test. Usually it will unmask simulation. He objected to the present method of making all calculations in fractions, and suggested that it would be better to take the lowest value as unity and designate all others in whole numbers. The notation of the vision, rather than the size of the letters, would then increase arithmetically, while the size of the letters would decrease geometrically. He proposed to assume as the basal factor for the geometric progression the decrease of the power to recognize form as we pass from the centre to the periphery of the macula, a factor fixed at 1.259. Test types thus arranged begin with Snellen 1, and the letters decrease in the ratio of the reciprocal of 1.259, or 0.794. The corresponding vision is expressed by whole numbers 1, 2, 3, etc., up to 12. The effect of the illumination should be taken into account.

(*b*) **The economic value of vision.** The vision necessary for the earning capacity, its relation to physiological vision, and the demands of different vocations.

A workman's earning capacity is not in direct proportion to his physiological or scientific vision, but depends on the demands of the work he performs. The limitations of such vision are narrower than those of the physiological, for while the latter comprises all degrees between 0 and perfect, the upper limit of vision needed for earning capacity is the worst which meets all the demands of a certain trade and permits the earning of the highest wages, while the lower limit is fixed by the degree of vision with which it is possible to earn any wages at all in that trade. Thus it differs in each trade and can be learned only empirically. A permanent decrease of wages may become apparent only after some lapse of time. According to Duchafour's table, the loss of an eye is estimated almost uniformly at $33\frac{1}{3}$ % in nearly all trades, but in reality the loss of an eye may entail a loss of wages varying

from nothing to 50 %. Such differences are explained by the varying demands made on binocular vision in the various trades. This matter can be cleared up only by a systematic examination of the vision of workmen in as many trades as possible, in which are noted the age of the workman, the exact kind of employment, his wages, his vision, and the degree of his binocular vision. Thus could be found not only the value limit of vision needed for earning capacity, but also its relation to physiological vision. The necessary work will be very great, and its results of corresponding importance.

Sulzer then spoke of the conditions in Switzerland and quoted the following propositions propounded by Haab and Pflüger: (1) The loss of vision in an eye is to be estimated in skilled workmen at 25 %, in unskilled at 20 %. (2) The total loss of an eye calls for an addition of 3 % when a glass eye can be worn, of 5 % in other cases. (3) The loss of the lens of an eye is to be estimated at from 13 to 20 %, according to the nature of the trade.

The speaker considered that the age of the person injured and the dangers of certain callings as important factors in an eventual change of occupation are matters for judicial rather than medical consideration.

(*c*) **How can observations be collected upon which can be based an estimate of the loss of wages consequent upon a certain loss of vision?**

The ideal answer to this question would be the formulation of a comprehensive tariff for all kinds of work. The formulation of such a tariff would be beyond the power of any one man, but in order to obtain some idea regarding the nature of such observations Sulzer investigated two trades, the cotton-spinners and the electric-light manufacturers. The work was very difficult, because the demands of the vision of the workmen varied enormously in the different subdivisions of these trades, which begin with the first working up of the raw material and end with the completion of the finished product. It is absolutely necessary to make these observations as broad as possible, for then only can an available formula or tariff be made from them.

2. Th. Axenfeld (Freiburg). **Damages for accidents in ophthalmology.**

An exhaustive paper, partly statistical, partly collated. The subject was considered under the following headings: **A. General part.** (1) Upper and lower limits of binocular vision

needed for the earning capacity. Relation of vision to earning capacity. (2) Various ways in which to estimate the earning capacity. (3) The value of statistics. (4) Ability to compete. (5) Age. (6) Habituation. (7) Actual and contingent results of accident. **B. Special part.** (1) Monocular blindness. Loss of one eye. (2) Monocular aphakia. (3) Impaired vision of one eye. (4) Irritability, blinding, symblepharon. (5) Disturbances of the muscular apparatus. (6) Disturbances of the visual field. (7) Injury to eyes already imperfect. (8) Accidents to eyes in the country.

His conclusions were that the percentage valuation of the earning capacity after injury to the eye can be only comparatively useful, and that it might be better to graduate the damages, as the injury is slight, medium, or severe, the indemnity thus serving not as a compensation for all possible injury but as a financial assistance. The loss in wages cannot be computed in a theoretical, mathematical way. A solution may be reached statistically through a compilation of observations, but with difficulty, because such great differences appear in the wages earned after identical injuries, and because the later wage relation is not to be used without further measure of the earning capacity. Individual approximations may be obtained for some injuries which approach the typical on the ground that the loss in the earning capacity should be estimated from that of others similarly injured, or an estimation may be made through such formulæ as Groenouw's. While it is desirable that the number of these shall increase, they have only a regional value. It is doubtful whether satisfactory solutions of the questions regarding vision necessary for the earning capacity and the damages due in case of accident could be drawn from a great accumulation of investigations. A purely subjective valuation can never be arrived at in many cases.

The vision needed for earning capacity seems to range from 0.75 to 0.15 (Magnus) or 0.1 (Groenouw, Truc) in the optically higher vocations, and from 0.5 to 0.02 in lower ones. The adjudication should take into account only the actual consequences of the accident, among which doubtless belongs competitive ability, as when a change of occupation is necessitated. The detriment to the earning capacity from a change of occupation can be computed from the experiences of those who have had to change their occupations. But the fact that an injury of an

eye which of itself causes little or no loss of earning power may become of great importance should the other eye be injured ought not to be considered, provided that under such circumstances a new adjudication can be had in which the first injury would receive a higher rating, even though the second eye be affected by disease having no relation to the injury of the first.

Ammann's proposition to let the maximum damages for the loss of an eye vary from 0 to 30 %, Axenfeld thinks should be rejected, and that not less than 20 or 25 % should be awarded to even unskilled workmen, because the loss of an eye works permanent injury. As the wages of the injured is the basis for the calculation of damages, the farmhand will receive a smaller amount. A fair indemnity seems to be 30 % for skilled, 20 to 25 % for unskilled. A permanent indemnity should always be given for the loss of an eye.

Injuries of the vision of one eye which do not interfere with binocular perspective, usually when not reduced to $\frac{1}{10}$, deserve no indemnity if a readjustment may be made in case of subsequent injury or disease of the second eye. For deterioration of vision to less than $\frac{1}{10}$, half the damages for the loss of an eye seems fair. The same is true of monocular aphakia, because the uncorrected vision alone is to be taken into account. The appreciation of perspective will play a greater part in future decisions than it has done in the past, and particular attention will be directed to when and to what degree monocular appreciation of perspective is learned after destruction of binocular. Vocations which require very stereoscopic vision demand special attention. With regard to habituation, a reduction of the indemnity can fairly be made a year or two after the injury. The reduction can be greater in unilateral, non-disfiguring blindness than after loss of an eye, and can be still greater in non-disfiguring aphakia, but there should remain a small permanent indemnity, say 10 %, and it is desirable that such a reduction should be referred to in the first adjudication.

The vision should be tested under conditions resembling those of the work to be done; in many callings the position of the face as regards a bright window should be taken into account. Further investigations are necessary with regard to the limits of binocular stereoscopy when the vision of each eye is impaired.

As long as muscular lesions cause diplopia and necessitate the closure of one eye, they are to be estimated at at least the loss

of an eye. If suppression of an image is brought about, the rate should be the same as in monocular aphakia, unless accompanied by great strabismus, when the rate should be higher. Regional diplopia with multiple paralyses must be estimated each case for itself. The disturbance of binocular stereoscopy should be considered more than it hitherto has been in heteronymous hemianopsia and unilateral narrowing of the field of vision. Anomalies of the field of vision as the result of accident are so rare that the medium rate is superfluous, especially since they, together with most muscular paralyses, are often associated with cerebral and nervous symptoms which demand greater attention. Too much heed must not be paid to the vision and too little to the conditions of irritation and dazzling, but the particular form of suffering must be taken into account. An indemnity of 5 or 10 % is often made in such cases, but this is too schematic. In order to determine in such cases whether improvement and habituation take place, it is well that unimportant improvement in the ratio between the work and the wages should be laid before the physician. Such facts should be presented before a readjustment is made. They do not influence the medical judgment, but they facilitate the determination of the earning capacity and of the habituation. They are instructive, furnish statistical material, and prevent excessive reductions from being made in cases in which a serious injury really exists. These observations should be made shortly after the resumption of work, and again for comparison a year later.

3. H. V. Würdemann (Milwaukee). **Traumatic impairment of vision and its influence on the earning capacity.**

Statistical data and a consideration of American conditions occupied a large part of this paper. The accident insurance companies of America indemnify the loss of vision of both eyes with the same sum as total disability, the loss of vision of one eye with from 12 to 50 % of that sum. The conclusions of the writer were: 1. The customs followed in giving pensions, insurance, and legal damages are wholly empirical. 2. The ratio of the earning capacity to the vision can be calculated mathematically. 3. The influence on the earning capacity can be determined in any case through the special damage to the vision. 4. A certain percentage of the sum assumed to cover total disability should be paid for partial disability. For the loss of one eye the indemnification should be between 18 and 30 % of that for total disability.

In the adjudication of proper claims the presumptive economic damage must be taken into account, and at the same time the loss in business, the expenses incurred on account of the accident, and an empirical valuation of the pain endured. 5. The mathematical calculations of Magnus, as modified by the author, furnish a suitable means for the computation of economic damages so that all parties and all legal claims receive full justice.

The presiding officer, KUHNT, then divided the subject into four separate questions, each of which was discussed separately.

(1) **The upper and lower limits of vision necessary for the earning capacity.**

PFALZ stated that the upper limit was usually said to be from $\frac{5}{5}$ to $\frac{3}{4}$, but as with $\frac{3}{4}$ the injury seemed to him too insignificant he proposed that $\frac{5}{5}$ be considered the upper limit.

HUMMELSHEIM recommended that the upper and lower limits be determined statistically for as many branches of work as possible. A tangible result would be that the absolute limit would be closely approached if sufficient material was accumulated.

MACHARDY considered an indemnity of 33⅓ % insufficient and recommended at least 50 %.

(2) **The percentage determination of the indemnity.**

AXENFELD disagreed with Sulzer and Würdemann that the indemnity could be computed mathematically independently of casuistry and empiricism.

SCHMIDT-RIMPLER agreed in general with Axenfeld, and to show how difficult, if not impossible, it is to estimate the real injury to the earning capacity he quoted a case in which, in spite of the loss of an eye, the same or more work was done by the injured person as was performed by other workers in the same line.

PFALZ considered it necessary to agree on the value of a lost eye as a basis for all other percentage calculations, as well as to avoid important differences in the awards. A good basis already established for the loss of an eye is 25 % for an unskilled workman, 33⅓ % for a skilled workman.

WICHERKIEWICZ said it did not seem right that a person with one eye, or monocular aphakia, who had learned to appreciate perspective and consequently suffered no loss of wages, should be given no indemnity.

CONSTANTIN advocated that the calculation of the injury to the wage-earning ability be based on the time required for the performance of a certain work, as the factor time is in inverse ratio

to the economic value of the visual apparatus. The time necessary for the performance of different kinds of work should be determined experimentally, first with normal vision and then with various degrees of artificially reduced vision.

(3) **Actual and potential results of accidents.**

PFALZ held that when no loss in earning capacity followed an accident it was better to forego a slight indemnity, because otherwise, if the second eye became diseased independently of the accident, he would not be apt to get an increased indemnity. Besides, small indemnities are harmful socially. It would be better to energetically insist that if the uninjured eye should later become diseased an indemnity should then be given.

AXENFELD moved as a resolution that when after injury of one eye the other becomes incapacitated later through disease there should be a readjudication of the first accident and a greater indemnity awarded. After an animated discussion the resolution was tabled.

(4.) **Blindness of and loss of one eye. Impaired vision of one eye. Impaired vision of both eyes.**

SCHMIDT-RIMPLER claimed that the usual determination of the vision for distance was insufficient for the estimation of the proper indemnity, and that the near vision should be taken into account. In cases of corneal opacity the near vision is often relatively worse than the distant.

JAVAL considered that what was needed was not a statement of the vision and refraction, but one of the practical loss of vision. A man with a high degree of myopia might be an excellent watchmaker and after loss of his lens have better distant vision and yet be incapacitated for his work.

Finally KUHNT suggested that the discussion had been of local rather than international interest and that a committee be appointed to consider the disputed points and report at the next international congress. This suggestion was adopted.

SECOND SESSION, SEPT. 15, 9 A. M., DE LAPERSONNE, OF PARIS, PRESIDING.

Discussion of the following propositions adopted by the French Ophthalmological Society.

1. The vision is determined through the minimum separabile, *i. e.*, the smallest angle with which two black points or lines on a white ground can be perceived as separate.

2. The interspace to be of the same thickness as the lines.

3. The vision to be inversely proportional to the differentiating angle.

4. The unit of measure for the vision to be represented by an angle large enough to enable the degrees commonly dealt with in practical ophthalmology to be expressed in whole numbers.

5. The arrangement to be a progression with the factor 1.259. The physiological reason for the choice of this number is that it expresses the diminution of the vision from the centre to the periphery of the macula, as recently established by Sulzer.

6. The vision to be expressed as increasing by 1 through tenths of a unit.

7. The unit of measure of the differentiating angle to be $\frac{1}{3}$ of a centiquadrant, or 10′ 48″, the vision thus to equal 0.0926, as compared with the system in use at present.

8. Test types to be adjusted so that the principle of minimum separabile will be employed as fully as possible.

9. The word "opt" to serve to designate the unit of vision.

10. These propositions to be submitted to the international congress at Lucerne.

LANDOLT said that in common with a considerable number of the members of the French Society he did not approve of two points in the propositions as presented. First, the adoption of the coefficient of progression 1.259 would greatly increase the difficulty of calculation. Instead of half, double, or triple vision, meaning that the same test type is read at half, double, or triple distances, 2 opt would not correspond to twice the vision of 1 opt, but to a vision 1.259 times greater. Difficulties would arise if one attempted to explain to a layman, say a judge, that 6 opt means a vision which is 1.259^6, *i. e.* 3.6633 times greater than 1 opt. If the designation opt should be chosen it should be applied to the unit of vision which corresponds to an angle of 1′, or 10′, and the decimal system should be retained.

In the second place, he protested against the division of the quadrant into 100 "centigrades," because it conflicts with the usual division of the circle, which is too firmly established to be readily overthrown. Besides, it is unnecessary, for if we take as the unit of vision that which corresponds to a visual angle of 10′ we can express the usual degrees of vision in whole numbers, and a simple calculation alone would be necessary to change

expressions in the old method into the new, while by accepting the opt and the centigrade great tables would be needed for this purpose and complications would be certain to arise.

With the exception of these two points, he favored the adoption of the resolutions by the congress.

MONOYER stated that there were at present more than twenty-seven optometric tables extant, at least one-third of which are based on different principles. The ophthalmological societies of Mexico and Paris have made an attempt to bring about unity. He was in accord with these propositions only as regards the principle of the method of measurement, otherwise he was not, and proposed instead :

1. The vision to be measured according to the principle of the minimum separabile.
2. The unit of vision to correspond to an angle of 1′.
3. This unit needs no special name.
4. The graduation to be expressed in decimal, arithmetic progression.
5. Vision to be tested at a distance of 5*m*. Test types to be blue letters on a black ground, and for the illiterate easily recognizable figures corresponding to the letters.

V. SIKLOSSY objected to Snellen's visual unit that the basal visual angle of 1′ is usually too large, as he had found the average angle in persons with normal vision to be 45″, which corresponds to a vision of 1.4 Snellen. Besides he thought it unsuitable to take as a unit of measure one of high value and to reckon in fractions when we are accustomed to choose as small units as possible to serve as units of measure. He proposed as the unit of measure that vision with which in a certain illumination a test object with a separable distance of 1*cm* is recognized at the distance of 1*m*. This he named "acuity." From this absolute acuity the relative acuity can be calculated. If an object 0.2*cm* thick is recognized at 7*m* the vision is 35A. 35A would correspond to Snellen's 1. The use of fractions would no longer be needed, but vision could be expressed in whole numbers. To obtain unity in illumination he had constructed an apparatus composed of a box with transparent test types illuminated from behind by incandescent lights of fixed energy. The illumination could be modified by the interposition of from 1 to 20 light absorbing glass plates.

LANDOLT hoped on account of the importance of the subject

that unity would be attained in the principle of measurement and in the designation of vision. This rests on four conditions:

(1) Attention to practical needs.

(2) Adoption of the principle of the minimum separabile.

(3) Does a unit angle of 1′ suffice?

(4) Is a single optotype needed?

SIEGRIST thought the first condition of an agreement would be the choice of a universal international optotype. Of Sulzer's lattice test he disapproved. For universal use he preferred Landolt's rings. As regards the designation of vision, he thought we should be contented with the substitution of decimal for common fractions. He therefore moved that the congress unite in the recommendation of Landolt's rings and the use of the decimal system.

BERRY considered Snellen's test types best for practical use, while for scientific purposes Reymond's squares may be preferred.

JAVAL seconded Siegrist's motion that a commission be appointed to consider the question of the determination of the vision and to report propositions at the next congress. He added that no one should serve who had published test types.

The following committee was named and accepted by acclamation: Nuel of Belgium, Hess of Germany, Jessop of England, Charpentier of France, Reymond of Italy, Dimmer of Austria, and Eperon of Switzerland.

SCIENTIFIC PAPERS.

1. ED. HUMMELSHEIM (Bonn). **A proposition to unify the designation of the meridians in astigmatism and in the visual field.**

Suggestions in favor of a universal nomenclature of the meridians have been repeatedly caused by its lack in the records of investigations regarding astigmatism and the visual fields. There are advantages and disadvantages of the symmetrical and identical methods of record, and the writer asked that the congress weigh these and decide which method is the preferable, the decision to be binding, the method chosen to be adopted everywhere and to be insisted on by editors of ophthalmological journals as a prerequisite for publication. Personally he pleaded for the adoption of the Snellen-Landolt symmetrical designation of meridians, in which zero is placed at the top of the vertical meridian and the other meridians are numbered to right and left to 90 in astigmatism, to 180 in delineations of the field. The only addition

necessary then is the word temporal or nasal to the degree of the meridian for its complete designation in any eye, an unimportant complication of the record. On the other hand, the identical method has this advantage, that the position of the axis in astigmatism, or of scotomata in the field, is immediately recognized through the number of the meridian.

2. H. KNAPP. **The symmetry of our two eyes to the median plane of the body as opposed to the asymmetry of the individual eye, with special reference to the meridians.**

KNAPP also strongly advocated the symmetrical record of the meridians. But though he formerly favored the method in which zero is placed at the top of the vertical meridian, further experience had induced him to recommend as the most convenient one in which zero is placed at the nasal end of the horizontal meridian and the meridians are numbered over to the temporal end to 180.

DISCUSSION.

GULLSTRAND did not think it necessary to choose an international designation of the meridians. The four names—nasal, temporal, supraorbital, and infraorbital, or more simply their initials, are internationally understood and serve to designate the ends of the principal meridians. Any intermediate meridian is designated by the initials of the principal meridians of the quadrant in which it lies, and the distance from the first is expressed by a degree. Thus any position of an axis can be expressed in four different ways, but without confusion as to the position of the axis in any particular case.

JAVAL recommended the adoption of the method used on most ophthalmometers and accepted by the Pan-American Congress in Mexico in 1896. The principle is the same as that chosen by Nachet in 1862.

After considerable further discussion, the congress declined to establish a fixed method for the notation of the meridians.

THIRD SESSION, FRIDAY, SEPTEMBER 16TH, 9 A.M., ARGYLL ROBERTSON PRESIDING.

3. GOURFEIN (Geneva). **The bacillus subtilis in eye diseases. Clinical and experimental researches.**

The bacillus subtilis was found to be the cause of acute conjunctivitis in 17 patients who had got earth into their eyes. It

was not found alone but associated with staphylococci and pneumococci. Its virulence was variable. It could be cultivated not only from the secretion, but also from the bits of earth which remained in the conjunctival sac. The clinical picture was in no way characteristic. Under treatment with silver nitrate the patients recovered in from six to eighteen days. In one case keratitis occurred in an old corneal opacity, in another there was a marginal ulceration of the cornea. Experiments showed that to produce a conjunctivitis in animals it was necessary for the bacillus subtilis to be rubbed into an injured conjunctiva; to produce ulcerative keratitis, it had to be injected into the parenchyma of the cornea. In the anterior chamber the bacillus caused a comparatively mild iritis, but in the vitreous it caused panophthalmitis, which ran a course varying in rapidity. Dacryocystitis could not be produced by it.

4. L. BUCHANAN (Glasgow). **Report of the examination of one thousand eyes enucleated in the Glasgow infirmary.**

In the course of nine years 163,000 patients have been treated at this infirmary and 1000 eyes enucleated, a proportion of 1:163. Six hundred and ninety-five eyes were enucleated on account of injury, 305 on account of disease. In all cases of sympathetic ophthalmia round-cell infiltration was found in the ciliary nerves, while micro-organisms were present in only 2 cases out of 14. The disease which most frequently led to enucleation was ulcerative keratitis, 122 out of the 305 cases, 38 of which were due to ophthalmia neonatorum, while ulcus serpens did not figure in a single case. Following in frequency were intraocular tumors, 48 cases; iridocyclitis, 36 cases; glaucoma, 29 cases; and tuberculosis of the eye, 9 cases.

5. GONIN (Lausanne). **The part taken by the vitreous in the various forms of detachment of the retina.**

GONIN advances the following opinon based on the anatomical examination of 70 cases of retinal detachment. Leber's theory is acceptable in all cases of spontaneous, idiopathic detachment of the retina if to it be added that the previous establishment of a chorio-retinal focus predisposes to the laceration of the retina at a certain place. The presence of lacerations can be demonstrated in sixty per cent. of the cases, but they may exist without being visible. But this theory is not satisfactory in cases of detachment with tumors of the choroid, nor in those with albuminuric retinitis and orbital abscess. It is also not perfectly

acceptable in cases of traumatic detachment, with the exception of a very small percentage, in which the detachment is caused by an inflammatory retraction of the vitreous with adhesion of the latter to the retina. In many cases hemorrhages behind the retina, or ruptures of the retina as the direct result of the traumatism, are the causes of the detachment, but most frequently the cicatricial contraction of the wound is productive of the detachment, particularly when the injury involves the anterior segment of the eye. Sudden collapse of the eye in consequence of loss of vitreous may also be a cause.

SCHEFFELS (Crefeld) claimed that Leber's theory was not acceptable in certain cases, because this could not explain spontaneous replacement. He favored the exudation theory, because he had seen detachment of the retina after the cauterization of the sclera in rabbits.

6. Mrs. Dr. GOURFEIN-WELT (Geneva). **The pathogenesis of detachment of the retina in albuminuric retinitis.**

The results of the anatomical examination of two cases of bilateral detachment of the retina in albuminuric retinitis are thus summed up: The subretinal exudation comes from the choroidal vessels and is a collection of fluid analogous to the œdema of other organs. The finely granular exudation on each side of the retina is from the same source. Active tension is not exerted on the retina because there were no adhesions between the vitreous and the retina. The separation of the vitreous is probably of later date. The tension of the eyes had not been increased during life.

7. v. HOFFMANN (Baden-Baden). **Modification of Bowman's operation by the excision of a wedge-shaped piece of mucous membrane.**

In cases in which slitting of the canaliculi does not suffice to correct epiphora, as in eversion and inversion of the punctum, stenosis of its aperture, flexion of the lower canaliculus in blinking, change of position from cicatricial contraction, or in facial paralysis, the writer has been accustomed for twenty years to remove a small, wedge-shaped piece of mucous membrane so as to change the position of the punctum to one deeper and nearer the lacus lachrymalis. The lower canaliculus is slit and an incision is made with scissors in the posterior lip of the wound, vertical to the incision of the canaliculus, and the little triangular flap of mucous membrane thus formed is removed with forceps and

scissors. The wound heals in from three to five days and leaves a permanently patent entrance to the canaliculus, while after the usual slitting operation a cicatricial contraction takes place, or the tears cannot escape over the inner lip of the wound.

In the discussion SCHEFFELS and MELLINGER stated that they had long been accustomed to perform this operation and had obtained good results.

v. HOFFMANN called attention to the fact that in eversion of the punctum the edge of the knife should be directed inward, in inversion outward.

8. TERSON (Paris). **The operative treatment of senile ectropion.**

The operation brought forward by the writer in 1896 has proved successful in 34 additional cases. In consists in the removal of the swollen, everted conjunctiva without suture of the margins of the wound, and the extirpation of a triangular piece of skin, the base of the triangle vertical along the outer margin of the orbit. In exceptional cases the base of the triangle may be placed obliquely so as to obtain a greater effect on the lower lid.

In the discussion each speaker preferred a different method.

9. C. REYMOND (Turin). **A simple apparatus to determine the relation between illumination and acuteness of vision.**

By the use of Nicol's prisms, which permit only the extraordinary rays to pass, the clearness of an object can be varied only between 0 and $\frac{1}{2}$. In order to be able to recognize all gradations between total obscurity and perfect clearness—*i. e.*, between 0 and 1, Reymond has constructed an apparatus of two pairs of Wollaston prisms. Each of these prisms doubles the image of the object, the combination doubles the distance between the images, the clearness of each of which is $\frac{1}{2}$. If one of the prisms is now turned about its vertical or horizontal axis, the two images divide into two more; the original ones are at first still clear while the newly appearing ones are obscure. When the prism has been turned 45°, all four images are equally clear with a clearness of $\frac{1}{4}$. Further rotation of the prism to 90° causes two images to disappear, and the remaining two have a clearness of $\frac{1}{2}$; at 135° all four again have a clearness of $\frac{1}{4}$, and at 180° there will be only a single image with a clearness of 1, because in this position the prisms neutralize each other. In this way, starting from the last-named position, the clearness of a certain object may be

reduced from 1 to 0, and the degree may be read from the markings on the setting of the prism at which a certain eye no longer perceives the second double image.

10. STEFF. SANTUCCI (Turin). **A characteristic symptom of tobacco and alcohol amblyopia.**

By means of Reymond's apparatus, just described, the writer has ascertained that with any illumination, natural or artificial, strong or weak, a healthy eye recognizes a commencing diplopia as soon as the prism has been turned a single degree from its original position, while patients with tobacco or alcohol amblyopia are unable to recognize the double images until the prism has been rotated from 10° to 15°, according to the severity of the disease. He considers this to be a characteristic symptom of the disease.

11. ED. ROLLET (Lyons). **Episcleral lymphoma and double-sided lymphoma of the lachrymal gland.**

The writer has seen a case of lymphoma at the corneal margin and of both lachrymal glands. The epibulbar tumor might have been mistaken for a sarcoma of the limbus, but the bilateral tumors of the lachrymal glands guided to the correct diagnosis, which was confirmed after removal.

12. A. DUANE (New York). **The development of strabismus.**

The disturbances of the eye muscles were divided into three groups: anomalies of the single muscles, of divergence, and of convergence. The usual concomitant strabismus arises through a combination of two of these groups, while alone each results in non-concomitant deviation. A non-concomitant squint of the first group usually becomes concomitant later as the original deviation increases. The cause of this change lies not in the muscles themselves but in changes in the centres which preside over convergence and divergence. The diplopia, which is very annoying to the patient at first, lasts only a short time, because he learns to suppress one of the images. The treatment of ordinary concomitant strabismus must be undertaken with regard to its complex nature.

In the discussion LANDOLT doubted if paralytic strabismus usually becomes concomitant.

DUFOUR has seen good results in the treatment of dynamic divergence with prisms.

13. E. EMMERT (Berne). **How does the axis of the astig-**

matism as determined by the ophthalmometer compare with the axis of the cylindrical glasses which correct the astigmatism?

An examination of over 2000 eyes with Kagenaar's opthalmometer shows a difference between the meridians indicated by the instrument and those of the correcting lenses. He does not think this can be ascribed with certainty to astigmatic accommodation and contents himself with the simple record of the fact. He used a system for naming the meridians which he calls "trigonometric," 0° is placed at the right end of the horizontal meridian and the meridians are numbered thence up to 360° [the identical system].

LANDOLT considers that the difference in the position of the axis for near and distance is due not to accommodative changes in the lens, but to the rotation of the globe during convergence.

14. E. EMMERT (Berne). **Causes of myopia. Treatment of progressive myopia.**

The writer no longer adheres to the theory he formerly advanced, that myopia was caused by the displacement of the optic nerve by the external rectus during convergence. He now ascribes the stretching of the sclera to a weakening of the tensor choroideæ, so that by relaxation of the choroid the sclera loses its power of resistance. While with healthy eyes a contraction of the tensor choroideæ accompanies accommodation, the tensor may yield, either from congenital weakness, or from weariness from overwork, at a near point, or from general bodily weakness, and so give rise to myopia.

LANG commented on the absence of elastic fibres in the sclera of a myopic eye.

15. L. DOR (Lyons). **The restraint, by means of extract of testicle, of the growth of children who grow too rapidly and in consequence show symptoms of ocular weakness.**

From the fact that castration in youth brings about a marked growth of the skeleton, the thought occurred to DOR to restrain over-rapid growth with extract of the testicle. Four rabbits were taken of equal growth. Three were injected subcutaneously with extract of testicle for four months. At the end of that time they were of less weight and had smaller bones than the control rabbit. For children of too rapid growth he recommends the administration of the dry powder in tablet form until the symptoms of weariness, especially those of the eyes, shall have disappeared.

The daily dose he gives as corresponding to 3 grammes of the fresh organ.

16. H. D. BRUNS (New Orleans). **Removal of the lens in high myopia.**

This operation is absolutely contra-indicated in middle and old age when disease of the choroid, fluid vitreous, or staphyloma is present. In the absence of any of these complications, the operation is not advisable at these ages because the best possible result does not compensate for the risk run. Young people, between the ages of ten and twenty-five, of over 12 dioptres myopia, should be operated on because their power of vision in later life is always endangered unless the operation is performed. A large discission with subsequent extraction should never be made; a large number of discissions should be performed and only one eye operated on at a time.

17. C. BAHR (Mannheim). **Early extraction of cataract after a ripening operation.**

To obviate the objection to Forster's operation that patients have to enter the hospital a second time, BAHR has made a successful attempt to extract a few days after the trituration of the capsule. His procedure is as follows: The anterior chamber is opened from above with a keratome, an iridectomy may or may not be performed, and then the greater part of the anterior capsule is rubbed with the exertion of considerable pressure for two minutes with a rubber spoon or glass spatula. Atropine is instilled and the eye bandaged for twenty-four hours. After five days the lens is extracted, when, according to the writer's observation, the lens leaves the capsule more easily and completely than after spontaneous maturation. The wound heals more quickly than after ordinary extractions, because of the new-formation of blood-vessels in the neighborhood of the wound made by the keratome. He had observed a reopening of the wound made by the keratome during the subsequent extraction only once. The only complication observed was subluxation of the lens in one case. There were no cases of infection. The secondary membranes were unimportant.

In the discussion SATTLER highly approved of Forster's operation, but believed it better to have at least two weeks intervene between it and the extraction. While many immature cataracts could be extracted without trouble, there were forms, such as those with no visible changes in the anterior cortex, when com-

plete blindness should not be awaited. He had never seen any harmful results from artificial maturation.

During the succeeding discussion some of the speakers were and some were not in favor of artificial maturation. Immediate extraction and extraction in the capsule were advocated by some.

KNAPP stated that he considered all operations to ripen cataracts artificially without opening the capsule to be uncertain. Always endeavoring to obtain not only the lowest percentage of losses, but also the highest permanently good vision, he prefers the slower, but safer, natural ripening to the artificial.

18. F. DE LAPERSONNE and POULARD (Paris). **Discission from behind.**

The writers have modified da Gama Pinto's operation by the adoption of a sickle-shaped little knife instead of a Graefe knife. This is passed through the sclera into the eye and the capsule divided from behind so that the margins of the wound will gape widely. This is performed about twelve days after the extraction.

DA GAMA PINTO stated that he had often performed posterior capsulotomy, but had returned to the anterior operation because he had once seen a detachment of the retina follow.

19. E. VITALI (Bari). **Capsulotomy and capsulectomy.**

VITALI prefers capsulectomy, because the thick secondary cataracts are caused by the capsule rather than the lenticular remnants. He operates under atropine mydriasis and uses a capsule forceps with which he removes a large piece of the anterior capsule. The portions of lens which remain after extraction are always dissolved and a clear black pupil is left. He thought immature cataracts might be operated on in this way with equally good results.

20. A. BOURGEOIS (Rheims). **Treatment of infection after cataract operations.**

BOURGEOIS recommends an immediate subconjunctival injection of ½ *ccm* of a 1:1000 solution of oxycyanate of mercury as soon as infection appears. When necessary the injections are to be repeated several times. He reported six cases with recovery, in four mild cases with preservation of perfect vision, in the other two, which were very severe, with good visual results.

ROGMAN makes prophylactic injections of Menzer's antistreptococcus and Roemer's antipneumococcus serum in cases of cataract operation in danger of infection from chronic conjunctivitis.

DA GAMA PINTO opens the wound, removes the exudation and applies the cautery thoroughly before making a subconjunctival injection.

MENACHO thought endogenous infection very rare, but BOURGEOIS held it to be more frequent.

21. A. DARIER (Paris). **The importance of local therapy by means of subconjunctival injections.**

DARIER still believes in the specific action of the different substances used for subconjunctival injections, and considers it confirmed by Wessely's observations, that there is a qualitative change in the fluidity and an increased number of antibodies in the blood of the eye. In contradiction to the results obtained by that writer, he believes an acceleration of fluid change is caused by injections of salt solution. These researches in common with those of Mellinger have made it impossible to deny any action to subconjunctival injections.

22. AUG. DUFOUR (Lausanne). **Subconjunctival injections of corrosive sublimate.**

DUFOUR uses solutions from 1:2000 to 1:10,000 with 2 % NaCl added, always in small quantities, not over $\frac{1}{2}$ *ccm.* After the injection, absolute rest with the eye bandaged should be maintained for two days. The pain is not severe if cocaine is employed. The duration of the pain is shorter than with oxycyanate of mercury. More than 8 injections should not be made. He has obtained good results in interstitial keratitis, opacities of the vitreous, post-operative infections, and, in particular, a bad ulcer of the cornea in purulent conjunctivitis.

23. A. SENN (Wyl). **My experience with subconjunctival therapy.**

During the last five years SENN has treated 463 eyes with subconjunctival injections. He uses a 2 to 4 % solution of common salt in herpes corneæ, ulcerative keratitis, traumatic keratitis, and retinal hemorrhage, and has been particularly pleased with its result in herpes corneæ. He uses a 1:5000 solution of oxycyanate of mercury in the central choroiditis of myopia, disseminated choroiditis, scleritis, iridocyclitis with opacities in the vitreous, serpiginous ulcer with hypopyon, and post-operative infections, and has obtained good results in all. The use of the cautery in serpiginous ulcer he confines to exceptional cases, and he believes that panophthalmitis from this form of ulcer belongs to the presubconjunctival age. Less certain results are to be

obtained in retinitis pigmentosa, detachment of the retina, and parenchymatous keratitis.

24. E. VITALI (Bari). **Treatment of hypopyon.**

VITALI states that usually the hypopyon disappears after a single subconjunctival injection of salt solution, every time after two or three injections. He therefore recommends this strongly, although he could not find that the injections exercised any influence over the ulcer itself.

25. A. ANGELUCCI (Palermo). **The action of the most common local eye remedies used in the normal way or diffusible substances occasionally in the blood.**

ANGELUCCI found the albumin in the aqueous increased after section of the cervical sympathetic, diminished by its irritation. Analogous results followed the subcutaneous injection of iodide of potassium or fluorescin. The effect of removal of the ganglion, or section of the nerve, was lost after a few months. Atropine, eumydrin, and duboiscin caused diminution of the albumin; cocaine, pilocarpine, silver nitrate, and dionin, an increase. He was unable to find any effect produced on the albumin in the aqueous by subconjunctival injections of salt solutions.

In the discussion on papers 21 to 25 WESSELY stated that he was skeptical regarding these injections in many respects, but the demonstration of physiological action by the effect on the albumin of the aqueous must induce the greatest skeptic to await the results of further researches.

FOURTH SESSION, SATURDAY, SEPT. 17, 9 A. M.

The session opened with a business meeting, at which it was decided to call the next International Congress after an interval of five years, to be held at Naples.

SCIENTIFIC SESSION, REYMOND OF TURIN PRESIDING.

26. Ch. ABADIE (Paris). **The less known varieties of glaucoma and their treatment.**

Especial emphasis should be laid upon those forms of chronic glaucoma in which there are intermittent attacks of very transient pain, haze, or chromatopsia. He thinks these forms have been too little considered and too frequently treated with myotics although iridectomy is the only correct treatment, because without it all such cases finally suffer from acute glaucoma and

blindness. The use of myotics should be restricted to absolutely pure cases of simple glaucoma, in which no objective symptoms can be detected by patient or physician. In simple glaucoma the excision of the superior cervical ganglion may be considered, but this operation is excluded in all cases that can be cured by iridectomy.

WICHERKIEWICZ agreed that iridectomy was the one means applicable to all cases of glaucoma, but its performance often reduced the vision, while by the use of a mixture of eserine, pilocarpine, and cocaine the vision might be maintained for a considerable time unimpaired.

27. E. EMMERT (Berne). **Treatment of severe eczematous keratitis.**

The following ointment is recommended for severe cases, particularly when associated with great photophobia and eczema of the surrounding parts.

Protargol 2.0.

Hyoscine hydrobromate 0.05 (eumydrin 0.1).

Vaseline or lanolin 40.0.

28. J. HERBERT (Bombay). **A singular form of conjunctival papule.**

A circumscribed swelling like a slightly injected papule can very often be seen in the region of the pinguecula among the natives of India. Upon it are little white specks which are stained by fluorescin and are shown microscopically to be leucocytes or collections of fluid. It is doubtless an inflammatory swelling of the pinguecula and is always unilateral. Under the microscope an excised papule shows an inflammatory infiltration, a thickening of the epithelium, and a degeneration of the elastic tissue.

29. J. HERBERT (Bombay). **Chromatophores in the human conjunctiva.**

Among the natives of India the conjunctiva normally shows no pigmentation, but in xerosis it is frequently found in the lower fornix. The pigment lies in fine granules, or larger masses, between the epithelial cells and in the tunica propria of the conjunctiva. Here also lie branching, pigmented cells which he will not class as Ehrmann's melanoblasts, because according to his observation all the conjunctival cells can pass from one form to another.

30. J. H. PARSONS (London). **Some pigment anomalies.**

PARSONS briefly described some cases of abnormal pigmentation of the conjunctiva, cornea, and sclera with reference to the question whether such eyes were especially predisposed to the growth of melanosarcoma.

31. E. V. GROSZ (Budapest). **The stamping out of trachoma in Hungary.**

The writer described the system in use now in Hungary, and advocated international action with a view to the universal suppression of the disease.

32. P. BAJARDI (Turin). **The microscopical examination of the conjunctival vessels in the living.**

BAJARDI believes that more positive results in regard to the pathological changes in the peripheral vessels can be obtained from an examination of the conjunctival vessels than from an ophthalmoscopical examination of the retinal vessels: first, because they can be seen better against the white sclera; second, because they react more readily to external irritation; and third, because they can be examined under a greater magnification.

33. A. MAZZA (Genoa). **A new case of transient lymph-circulation or infiltration of the cornea.**

In a severe case of syphilitic iritis the following phenomenon was noticed. After the head had been held bent over for some time a white spot would appear on the cornea of the inflamed eye and disappear in a few seconds after the head had been raised to its normal position. This phenomenon was observed for a number of days, but disappeared as the eye got better. The white spot was triangular, with its base downward, and occupied the lower part of the cornea. As it disappeared, longitudinal stripes of opaque fluid could be seen with the loupe within the most superficial layers of the cornea. The writer thought as Rampoldi had in a similar case, that the symptom was due to a lymph stasis in the cornea caused by obliteration of the marginal vessels by the chemosis.

34. E. HOUDART (Brest). **Simultaneous septic ophthalmia and abscess of the liver in a patient suffering from dysentery.**

A metastatic ophthalmia and almost simultaneously an abscess of the liver appeared in a patient with dysentery. The intraocular suppuration broke into the lens at a very early stage so the clinical picture resembled that of a lenticular abscess. Later the eye was enucleated. The intraocular pus contained staphy-

lococci and streptococci, while that of the liver abscess was sterile.

35. C. HARMS (Breslau). **Hemorrhagic retinitis in consequence of disease of the central artery of the retina and its branches.**

Contrary to the old theory that large spontaneous retinal hemorrhages were caused by the acute anæmia of the retina resulting from closure of the central artery, several authors have recently demonstrated anatomically that they may be due to disease of the arteries. The eyes present the picture of retinitis hemorrhagica with marked endarteritis proliferans, while the veins are normal. The writer is opposed to this view on the ground that with the usual methods of investigation closure of the veins for short distances can too easily be overlooked. He has made a continuous series of sections of the optic nerve far into the lamina cribrosa, and from these reconstructed the entire course of the vessels in three eyes, two of which presented the picture of retinitis hemorrhagica and one of embolism of the central artery. In the first two cases there was endarteritis proliferans, in the third an obstructive disease of the veins as the primary cause of the anatomical picture, but even in the two cases of retinitis hemorrhagica there was complete closure of the central vein in the region of the lamina cribrosa, and in the other case a plugging of the artery by a thrombus. These results show how careful one must be in the interpretation of anatomical findings in such cases and speak well for the old theories regarding these diseases.

36. CONSTANTIN (Geneva). **A case of monocular diplopia of retinal origin. A contribution to the theory of inversion of the retinal picture in vertebrates.**

CONSTANTIN described a case of detachment of the retina after a perforating wound, in which the entire upper part of the retina was turned about and became so placed before the portion still attached that the layer of rods and cones was turned forward. Hence resulted the phenomenon, with a vision of $\frac{1}{60}$, that the patient saw a double image of each object, one image below the other, the lower one inverted. The latter he considers the inverted image seen by the detached retina, and thinks this inversion of the retinal picture furnishes a contribution to the explanation of upright vision, and that it might be imagined that the inversion of the eyes of vertebrates was brought about to counteract the inversion of the picture produced by the lens.

37. MORAX (Paris). **Ophthalmological nomenclature.**

MORAX spoke in favor of retaining the original name of a disease, a symptom, a method of examination, with the addition of the name of the author, instead of having the names changed with the advance of our knowledge of disease, even when the original name was less mentioned than the latter.

In the discussion HALBEN claimed that with advancing knowledge the nomenclature must change.

38. C. ADDARIO (Palermo). **Senile involution of the vitreous and its matrix, the ciliary body.**

ADDARIO has established by anatomical investigations that in the eyes of old people the non-pigmented epithelium of the posterior part of the ciliary body, which deals with the nutrition of the vitreous, undergoes a process of rarefication with shrinking of the cell protoplasm, whence result rarefication and shrinking of the vitreous fibrillæ.

39. TSCHERNING (Paris). **Daltonism.**

TSCHERNING has invented an apparatus by means of which he has arrived at the following conclusions:

The curves are the same for all named forms in the blue portion of the spectrum, but differ in the remaining portion. The curve of the protanopes is distinguished from that of the normal trichromates by the complete absence of red perception. With anomalous trichromates the red curve exists as with the normal, yet it requires much more green to produce a yellow tone than the former, which is expressed in this place by a high rise in the green curve. The deuteranope has a curve which exactly corresponds to that of the anomalous trichromates except that again the red curve is completely wanting. The high rise of the green curve, which is consequently peculiar to the two last named anomalies, depends not on a lack of sensitiveness to green, for then the spectrum would appear shortened in the region of the red to deuteranopes, but to a very strong perception of the green in the yellow color tones.

40. A. MEISLING (Copenhagen). **An apparatus for mixing colors and investigating color blindness.**

Two incandescent electric lights let their rays pass through red and green colored filters, each provided in front with a diaphragm, and fall upon a pane of dull glass in a screen. The screen may be moved so that the colored lights fall upon it at various angles, and thus an easily calculated mixture of colors can be

obtained. While the lower part of the pane is illumined by the white light from an incandescent burner screened from the rest of the pane, the color-blind can make his comparison of colors appear by moving the screen. The apparatus can be used for mixing any desired colors, or for the investigation of colored shadows.

41. K. Noisezwski (Duenaborg). **Purkinje's phenomenon and the adaptation of the retina.**

The explanation of Purkinje's phenomenon that red appears darker than blue in the dusk is still under discussion. It is asked how far this is a subjective phenomenon, or how far it is caused by absence of the red rays from absorption in the atmosphere, or from weaker refraction. The writer has experimented with a so-called chromoscope, a fac-simile of the spectrum in colored wool, and has taken as a basis the distance from a candle flame that the red and the blue colors appear black. He found thus the distance for red to be 20*m*, that for blue 23*m*, only a slight difference. He then made a similar experiment in a dark corridor into which daylight entered only through a little slit, and found at midday a very different proportion in the distance required for red and for blue, viz, 1:16, which shows a proportionate clearness of the illumination necessary for the recognition of the colors of $1:16^2$—*i. e.*, 1:256. Still more surprising was the difference when the same experiment was made in the dusk. The red could then be recognized as such at a distance of 1*cm* from the slit, while blue appeared black first at a distance of 16*m*. In other words, 2,560,000 times greater clearness is necessary for the recognition of red than for the recognition of blue in the twilight. At that time the blue and violet rays greatly preponderate. That statement is only apparently not in consonance with the fact that one cannot photograph well at this time, because the light at midday contains an actually greater number of actinic rays than the natural twilight, which on the other hand contains more rays than artificially produced twilight.

42. Javal (Paris). **Rapid determination of sensibility to light.**

Javal uses a telescope tube with a photographic negative at the end on which are letters of various sizes, formed of separate black points corresponding in size to the letters. When the light passes through, the letters appear as formed of larger or smaller bright points. The determination of the light sense can be made

in three ways: (1) by determining how many less letters are seen by the diseased eye than by the well one; (2) how much shorter the tube must be made to enable the diseased eye to see as well as the sound one; (3) with what diaphragm both eyes recognize an equal number of letters.

43. Ed. Pergens (Maeseyck). **The legibility of printed letters.**

Pergens used in his studies Latin letters without calefs at the ends of the strokes as well as uncial letters. The height of the letters subtended an angle of 5 minutes at the distance of 50 metres, and the breadth of each line subtended an angle of 1 minute. He divided the letters into four groups:

1. Those formed of straight lines at right angles (I, L, F, etc.).
2. " " " " " " other angles (V, W, M, etc.).
3. Those formed of curved lines (O, Q, C, etc.).
4. " " " " and straight lines (P, B, R, etc.).

He found that, as a rule, the addition of apices lessened the legibility of the letters.

44. K. Grossman (Liverpool). **The Sanson–Purkinje reflex from the anterior capsule.**

This reflex is best observed when the angle of incidence of the rays from a gas flame is 60°. The writer has found by very exact observation that when the entire anterior surface of the lens is examined with the reflex the latter appears to be interrupted by black lines which mark out the six- or seven-rayed figure of the star-like arrangement of the fibrous structure of the lens. Hence it is certain that the reflex comes not from the capsule or the epithelial layer, but from the most anterior layer of lens fibres. In confirmation of this he sometimes observed an iridescent sheen of the reflex in very young people, and saw in a case of anterior polar cataract the reflex at the margin of the latter within the lens.

45. E. Treacher Collins (London). **Development of the power of accommodation of the human lens.**

From his embryological studies regarding the development of the fibres of the zonula, Treacher Collins is unable to state with certainty whether the cells of which they are formed are of ectodermal origin, like the ciliary epithelium, or mesodermal, like the vascular lens capsule. But it could be shown how the separate decussating bundles of fibres of the zonula originated at different

epochs of development of the eye and acquired their decussation from the backward change in the position of the lens at the formation of the anterior chamber. In confirmation of this it may be noted that in the lower animals the separate stages of the development of the zonula are found as permanent conditions, and that an arrest of development can be proved in congenital microphthalmos.

46. KNAPP (New York). **Dependence of accommodation and motility on the refraction; their investigation and treatment.**

KNAPP uses Stevens's phorometer to determine latent hyperopia. After fitting with glasses he has the patient look at a distant light. The phorometer shows the degree of esophoria through homonymous double images which gradually lose their lateral position after placing convex glasses before the eyes of the patient. The phorometer thus makes latent hyperopia manifest while the convex glasses annul the convergence associated with the accommodation. For treatment Knapp uses the full correction for distance and near.

47. G. AHLSTRÖM (Gothenburg). **The paths of rotation of the eye.**

AHLSTRÖM has investigated the tracks followed by the eye in rotation, using the method of after-images. One eye observes little phosphorescent points arranged like meridians about a central point to the distance of 40° on a dark screen, while the other eye is dazzled by rays from an arc-light coming through a narrow aperture. Now if the eyes are moved, the direction of the movements can be directed by the one eye fixing the light points of the meridians, while at the same time the other eye sees the exact course of movement by the linear after-image. In this way he has determined that the passage of the eye from the primary to the secondary position corresponds exactly to the meridian. But on passage to a third position the course takes the form of a slight curve with its concavity toward the vertical meridian, its convexity toward the horizontal. On passage from one tertiary position to another the form of the after-image is that of a slightly S-shaped line.

48. L. HOWE (Buffalo). **The rapidity of lateral eye movements, especially under pathological conditions.**

HOWE has measured the movements of the eye by light let fall through a narrow slit upon the cornea, and photographing the

reflex on a vertically rotating film. The straight line on the still eye forms the base line of the curve. In comparison with normally quick and well executed lateral movements of the eye, restricted or slow movements give a curve less steep and high. By this means it is possible to recognize motor defects which escape in an ordinary examination.

49. M. SACHS (Vienna). **Disturbance of ocular motility of labyrinthine origin.**

SACHS described a case in which shortly after an operation for caries of the petrous portion of the temporal bone, during which a portion of the horizontal semicircular canal was removed, paresis of both abducens appeared. When the patient looked to the right or the left both eyes turned properly to that side, but after a short time the abducted eye would return to the middle line. His explanation of the connection of this phenomenon with the removal of the semicircular canal is as follows: The turning of the head is so connected with the rotation of the eyes that normally in prolonged fixation a change in the position of the head always relieves the forced rotation of the eye. In this case the accurate co-ordination of the lateral turning of the head had been lost in consequence of the destruction of the left horizontal semicircular canal, and therefore in lateral fixation the lateral motion, at first good, would be replaced by a position of convergence—*i. e.*, by a muscular act independent of the orientation on account of the position of the head at any time.

50. H. PARSONS (London). **Notes on the neurology of the eye.**

A. Dilatation of the pupil from irritation of the cortex of the brain.

PARSONS has obtained in monkeys, less successfully in dogs and cats, a dilatation of the pupil with associated symptoms like those produced by irritation of the cervical sympathetic after cortical irritation of the eye muscles in the frontal and occipital lobes. Section of both cervical sympathetics weakened the effect, an additional section of the oculomotorius destroyed it altogether.

B. The vasomotors of the eye.

From the readings of a manometer communicating with the anterior chamber, PARSONS demonstrated the vaso-constriction of vessels within the eye, and showed that irritation of the cervical sympathetic produced a decrease of tension, therefore vaso-constriction, more slowly but for a longer time than dilatation

of the pupil. This demonstration can be performed on dogs, but when cats are used the effect is concealed by a compression of the globe by the orbital muscles.

51. St. Bernheimer (Innsbruck). **Further researches regarding the location of the centre for the sphincter pupillæ.**

The writer has demonstrated both anatomically and experimentally that the small-celled medial nucleus in the nuclear region of the oculomotorius is the nucleus of the sphincter. By unilateral destruction of this nucleus in a monkey, he had produced a dilated pupil irresponsive to light in the eye on the same side, and this had remained unchanged till the animal's death four weeks later. He had tried to follow the centrifugal pupillary fibres toward the eye. On account of the difficulty of the experiment he had been unable to repeat the isolated destruction of the sphincter nucleus, yet the failures were instructive. The anatomical examinations showed that in the experiments in which the pupils remained uninfluenced the medial nucleus was always uninjured. They also showed that destruction of the roof of the corpora quadrigemina is of no importance to the pupils. Finally three of the negative cases in which the fibrous tract between the lateral region of the corpora quadrigemina and the region of the oculomotor nucleus was injured teach that these fibres have no influence on the pupils.

52. E. Wehrli (Frauenfeld). **Microscopical examination of a case of mental and cortical blindness with regard to the cortical localization of the macula.**

This case was one in which there suddenly appeared a hemianopsia of each eye, permanent loss of central vision, loss of memory of visual images, incapacity to localize in space, and mental blindness of one eye. After three weeks some perception of light returned to the right half of the field. On autopsy there was found a thrombosis of the occipital artery with older, symmetrical softenings on each side of the calcarine fissure. Macroscopically the softenings appeared to be wholly confined to the cortex, but microscopically there were zones of degeneration in the medulla with secondary degeneration of the optic radiations. No conclusion could be drawn regarding the delimitations of the cortical centre of the macula.

53. M. E. Valude (Paris). **Ethyl chloride for general anæsthesia.**

Ethyl chloride is recommended for brief narcosis because a

few inspirations suffice to put the patient in a deep narcosis lasting perhaps three minutes. About 8*ccm*, is poured on gauze either held in the hand close to the mouth and nose of the patient, or better by means of a mask devised by the writer in which a glass tube containing 8*ccm* of ethyl chloride is placed, the point of which is broken after the mask has been secured in place and its contents allowed to escape into a tampon. If the narcosis is to be maintained longer than three minutes an additional 3 to 5*ccm* is to be inhaled. The advantages over chloroform are short duration, no stage of excitement, no vomiting, no after-effects, very rarely syncope, and only one death in 7000 cases.

54. D. Basso (Genoa). **Extirpation of the lachrymal sac and lachrymal canal.**

It is important to remove the mucous membrane of the lachrymal canal with the sac because it is usually diseased prior to the disease of the sac itself. Curettage and cauterization are insufficient. During the operation, which begins as an ordinary extirpation of the sac, the latter must not be opened. With a long, straight elevator the membranous tube of the lachrymal duct is isolated, and where it is adherent to the bone it is loosened with a small lenticular knife. After this has been done, the tube is drawn out with forceps, usually with a little piece of the nasal mucous membrane which has been torn away. Healing takes no longer than after the usual operation of extirpation of the sac.

55. S. Holth (Christiania). **Tattooing the cornea in colors.**

By experiments on animals Holth has decided that the best pigments to use in tattooing a representation of the iris on the cornea are as follows: for black, lampblack; for red, cinnabar; for brown, a mixture of the above, oxide of iron, terra de Siena, or sepia; for yellow, red terra de Siena; for blue, ultramarine. These pigments are washed with water, alcohol, and ether, and the wet ether filtrate evaporated over a water bath, and then sterilized for half an hour in a temperature of 150°. The pigments when ready for use are in the form of a very fine powder, which is wet with a little well sterilized gum-arabic solution. The margin of the pupil and the outer periphery of the iris are marked out by sharp-edged cylinders on the leucomatous cornea, and the corneal epithelium is removed from the desired region between the furrows thus formed. This portion is then thoroughly

pricked with a bundle of needles, which is then dipped in the pigments and used to prick the surface again. A single tattooing will often produce a permanent result, but frequently several sittings are necessary.

56. A. Emrys-Jones (Manchester). **To obtain a good stump after an ordinary enucleation.**

Jones recommends to enclose beneath the conjunctiva a glass ball, the same as used in Mules's operation.

57. J. E. Weeks (New York). **Formation of a sac to retain an artificial eye when the conjunctival sac is completely obliterated.**

The disadvantage in operations of this character has hitherto been the contraction of the transplanted skin. To avoid this the writer recommends to fix it partially on the immovable periosteum of the margin of the orbit.

58. Fr. Schanz (Dresden). **A new apparatus for aiming.**

Presbyopes who are hunters often complain that when aiming a gun they are unable to see with sufficient distinctness the rear and front sights at the same time. This trouble cannot be corrected by glasses. It occurred to Schanz that by reflection the two sights could be placed at a greater distance so that there would be much less strain of accommodation in fixing the object aimed at and the sights. He changes the sights and replaces the one near the muzzle with a small metallic mirror. In this the gunner sees the reflection of the rear sight which is T-shaped and must be so placed that its horizontal arm passes through the edge of the front sight in the mirror picture. In this way, with the majority of German military guns, the accommodation of the gunner would act only from infinity to 110*cm* instead of 50. For those who are not presbyopic, this arrangement allows a greater accuracy in aiming because the circles of dispersion from the front and rear sights would be correspondingly lessened. A patent has been applied for.

59. A. Chevallereau and J. Chaillons (Paris). **Etiology of iritis.**

One hundred and thirty-one cases of iritis were observed—76 in men, 55 in women. The great majority were between the ages of twenty and fifty ; 8 were younger, 18 were older. Syphilis was the certain cause in 36, the probable cause in 13; gonorrhœa, with joint affections, in 9; articular rheumatism in 7, uterine troubles in 8, and tuberculosis in 9 cases. Diabetes and nephritis

were causes in a smaller number of cases. Although the older cases were excluded, on account of the difficulty in determining the etiology, in 27 out of 131 cases the cause could not be ascertained.

60. MOTAIS (Angers). **Transmission of sympathetic ophthalmia by way of the veins.**

MOTAIS considers the anastomoses between the veins of the two eyes the most probable track for the passage of sympathetic ophthalmia. There is free communication both in the facial system through the plexiform union of the two angular veins, and in the intracranial through the union of the sinuses. The entire field is free from valves, so that in case of venous engorgement, from straining or other cause, blood can run back into the eye from the great venous trunks. In this way irritants could be carried from one eye to the other. Clinical and experimental bases for this theory are as yet wanting, but it is assumed that ligation of the angular veins would reduce the probability of an attack of sympathetic ophthalmia.

61. A. POLACK (Paris). **Manifestations of chromatic aberration of the eye.**

Investigations of artists have shown POLACK that even the slightest ametropia has a notable influence on the perception of colors. Experiments on himself with Wecker's color scale showed that by the interposition of convex glasses red appeared more saturated, yellow more orange, and green slightly yellowish, while with concave glasses blue appeared more saturated, green more blue, and yellow greenish. His explanation is that the eye can be accurately accommodated only to one component of a mixed color. When the colors of the spectrum were used, this appearance was wanting. He recommends for artists no correction for slight myopia, but over-correction for hypermetropia, because for the artist the so-called warm colors should prevail.

DEMONSTRATIONS.

WEDNESDAY, SEPTEMBER 14TH, 2 P.M. FUCHS, OF VIENNA, CHAIRMAN.

1–3. WEHRLI, COLLINS, and ADDARIO demonstrated microscopic specimens illustrating their papers.

4. DIMMER (Graz), an apparatus for the photography of the fundus.

5. BOURGEOIS (Rheims), Daviel's original instruments.

6. STRAUB (Amsterdam). **Monocular stereoscopy.** It occurred to the writer that he saw the optic nerve stereoscopically while looking at it with the ophthalmoscope and making quick lateral movements of the convex lens to determine the parallax. Hence, by means of a straboscope, he was able to produce monocular stereoscopic vision. This he demonstrated in a series of pictures.

7. BEST (Giessen) showed specimens illustrating the microscopic iron reaction which forms chalky deposits in the eye. He described the results obtained by the treatment of microscopic sections with iron salts and Prussian blue. The red-blood corpuscles and muscle fibres are particularly well stained, and hitherto unstainable structures in the nerves, such as the axis-cylinders with the so-called inter-infundibuli. The ciliary nerves normally have regularly arranged inter-infundibuli, with short intermediate spaces, while they are absent in the optic nerve.

8. HARMS (Breslau). Specimens illustrative of his paper.

9. HUMMELSHEIM (Bonn) exhibited a sterilizable, fast-closing bottle for eye-drops.

10. HALBEN (Greifswald). **Macroscopic preparations of the eye for purposes of instruction.**

HALBEN's preparations are blocks of celloidin or photoxylin, hardened in chloroform vapor, cleared in chloroform and oil of cedar, properly cut with a sharp knife, and, after superficial drying, covered with a varnish made for the purpose, which gives it a smooth transparent surface and prevents evaporation with attendant changes. The advantages of this method over the use of glycerin-gelatine are that the preparations are more easily carried about, are more transparent, and can be viewed on all sides both by direct and transmitted light. A further advantage is that if microscopic sections should be desired at any time they can be taken without destroying the specimen as such; the varnish alone would have to be renewed.

11. ASHER (Berne). **An apparatus for the mixing of the colors of the spectrum.**

This apparatus is made with the aid of a lattice. It possesses two lower and two upper slits which fill an upper and lower half field with two spectral colors. The slits may be widened or narrowed by means of a screw, and thus the intensity of any individual light may be regulated. It also possesses a contrivance

by means of which white light may be admitted to one half field. The apparatus is not of large dimensions.

12. K. WESSELY (Berlin). **Ophthalmoscopic appearances and microscopical preparations of artificially produced detachment of the retina in animals.**

In order to determine whether there was any truth in the objections raised to the exudation theory as an explanation of the origin of detachment of the retina, WESSELY undertook to produce blisterlike detachments by scalding with steam. For this purpose he constructed a little apparatus with which he applied hot steam to circumscribed places on the exposed scleræ of cats and dogs. Large detachments were thus obtained which extended up to sixteen dioptres into the vitreous without producing increase of tension. Anatomically there were great hyperæmia of the choroid and a very large exudate rich in albumin between the choroid and retina. The detachments showed the phenomenon of sinking, the same as spontaneous detachments in the human eye, and would reattach after scleral puncture and reapposition. In a week spontaneous replacement usually took place. Wessely states positively that he is unable to show the general validity of the exudation theory as the origin of the spontaneous detachments of the retina in the human eye, but that his experiments remove theoretical objections in cases in which an exudation would be clinically suggested.

13. POLLACK (Berlin) exhibited several preparations of the retina and optic nerve made according to the new method of Bielchowsky.

14. LANGE (Brunswick). **The cause of myopia.**

LANGE exhibited specimens of the sclera in myopic and emmetropic eyes. While in an emmetropic eye an abundant network of elastic fibres is everywhere present, in myopic eyes they are markedly deficient if present at all. That their absence is not simply apparent on account of imperfect staining of the slides was shown by the beautiful staining of the elastic fibres in the coats of the scleral vessels in the same sections. Hence he believes that progressive myopia is due to a congenital lack of elastic fibres in the sclera.

15–16. MOTAIS and HOWE presented exhibits illustrating their papers.

17. SIEGRIST (Berne) exhibited a modification of the Javal-Schiötz ophthalmometer. The steps of the mires are replaced

by lines which cross at right angles, and the transparent, electrically lighted mires are colored red and green.

18. SCHANZ (Dresden) exhibited a gun with his new arrangement of sights which presented an additional improvement in a means to illuminate the front sight in the dusk.

Forty scientific papers were then read by title.

SYSTEMATIC REPORT ON THE PROGRESS OF OPHTHALMOLOGY IN THE FOURTH QUARTER OF THE YEAR 1903.

By Dr. G. ABELSDORFF, in Berlin; Prof. ST. BERNHEIMER, in Innsbruck; Dr. O. BRECHT, Prof. R. GREEFF, Prof. C. HORSTMANN, and Dr. R. SCHWEIGGER, in Berlin; with the Assistance of Prof. A. ALLING, New Haven; Prof. E. BERGER, Paris; Prof. CIRINCIONE, Genoa; Dr. DALÉN, Stockholm; Prof. HIRSCHMANN, Charcow; Dr. J. JITTA, Amsterdam; Mr. C. DEVEREUX MARSHALL, London; Dr. H. MEYER, Brandenburg; Dr. P. VON MITTELSTÄDT, Metz; Dr. H. SCHULZ, Berlin; Prof. DA GAMA PINTO, Lisbon; and Others.

Translated by Dr. WARD A. HOLDEN.

(Concluded from page 122 of this volume.)

XII.—CORNEA.

523. **De Lieto Vollaro, Agustino.** The pathological anatomy of arcus senilis. *Annali di Ottalm.*, p. 478, 1903.

524. **Gallenga.** A contribution to the knowledge of congenital, opaque ectasias of the cornea following intrauterine keratitis. *Arch. di Ottalm.*, July, 1903.

525. **Hadano.** A contribution to the knowledge of keratitis disciformis. *Zeitschr. f. Augenheilk.*, x., 6, p. 500.

526. **Baquis.** A rare form of keratitis. *Ann. di Ottalm.*, 1903.

527. **Golesceano.** The sensibility of the cornea in interstitial keratitis. *Bull. et mém. de la soc. franç. d'ophtalmologie*, 1903, p. 333.

528. **Peters.** On traumatic affections of the cornea (erosions, keratitis disciformis, and ulcus serpens) and their relations to herpes of the cornea. *Graefe's Archiv*, lvii., 2, p. 93.

529. **Hansell.** Two unusual forms of keratitis, probably rheumatic in origin. *Ophth. Record*, Nov., 1903.

530. **Stephenson.** The corneal lessons in acquired syphilis. *The Ophthalmoscope*, Nov., 1903.

DE LIETO VOLLARO (523) confirms the results found by Takayasu and Fuchs in arcus senilis. The fatty granules belonged to the groups palmatin and stearin.

He bases his views on the clinical and pathological examination of a case of congenital cloudy ectasia of the cornea with consecutive secondary glaucoma.

GALLENGA (524) agrees with Haab that these cases are not the result of intrauterine perforation of the cornea, but rather an ectasia of the cornea following fœtal irido-cyclitis. In Gallenga's case there were in fact marked atrophic changes in the anterior portion of the uveal tract, while the lens, although having undergone nutritive disturbances, was not dislocated. And furthermore the changes in the corneal tissues were more marked in the deeper layers than in the superficial.

A satisfactory explanation of the case is found in the presumption that it resulted not from a non-primary inner ulcer of the cornea, but from such an ulcer following a severe inflammation of the anterior portion of the uveal tract. CIRINCIONE.

HADANO'S (525) report is a continuation of a case history in *Graefe's Archiv*, xlvii., 2, p. 93. In this case of keratitis disciformis a sharply outlined disc-shaped opacity was removed with a sharp spoon. Only after this procedure did the healing process advance. The symptoms of irritation caused by the operation were successfully combated with quinine. Examination for micro-organisms was negative. The author agrees with Peters that not only in herpes but also after injuries of the cornea processes occur which are of neurogenic origin and have no inflammatory character.

BAQUIS (526) reports a typical case of Fuchs's disciform keratitis in a lymphatic patient. The course is slow, the duration about 12 months. According to the author there was in his case a circumscribed degeneration of the corneal epithelium in an eye previously healthy. CIRINCIONE.

GOLESCEANO (527) determined the sensibility of the cornea in 29 cases of interstitial keratitis. He found the most varied forms of anæsthesia, sometimes in the upper, sometimes in the lower part. Again, the middle of the cornea alone might preserve its sensibility, or might alone be anæsthetic. In many cases only the nasal or temporal portion of the cornea is anæsthetic. The author believes that an injury of the anæsthetic zone of the cornea may be of great danger to the eye, but he does not support his idea by facts. BERGER.

From PETERS'S (528) valuable paper the following conclusions are taken:

In cases of corneal erosion disturbances of sensibility are the rule, not only after the original injury, but also particularly after the recovery from the recurrences. The œdema which renders the epithelium easy of removal, or that forms vesicles in the epithelial layer, may involve the deeper layers of the cornea and give rise to striations on the posterior surface. This œdema is of neurogenic origin. Keratitis disciformis and erosions are but slightly different. Ulcus serpens also is allied, and there is no radical difference between these three affections.

In ulcus serpens the peripheral nerves have been affected by an injury, while in herpes an irritation of a nature yet unknown affects the peripheral nervous apparatus and the tissues it innervates.

The first case described by HANSELL (529) was characterized by infiltration of the cornea in the form of intersecting lines in its substance, which was otherwise clear. The salicylates and arsenic caused rapid disappearance of the lesion, which may be classified as the "lattice-work" keratitis of Beber. The other case presented about twenty-four small gray spots just behind Bowman's membrane and would be designated as superficial punctate keratitis, also of rheumatic origin. ALLING.

STEPHENSON'S (530) paper was read before the annual meeting of the British Medical Association. He describes a case of Mauthner's punctate keratitis and then goes on to point out the connection between acquired syphilis and interstitial keratitis. Recorded cases of this nature are given and a case of this sort is described in detail. He also described a case that occurred in his practice which shows how easily primary syphilis may be overlooked in infancy. The child when he saw her was twelve years of age without any evidence of hereditary syphilis. A patchy parenchymatous keratitis was present in one eye. Under mercury an astonishingly quick recovery was made. It was then found that when two or three months old the patient had developed an obstinate sore on the upper eyelid and that this had been followed by a widely spread eruption with cutaneous ulceration and a state of prolonged debility. The keratitis was in this case probably due to acquired syphilis.

The shortest case recorded in which interstitial keratitis followed acquired syphilis is three weeks and the longest time is twenty-three years. MARSHALL.

Sections XIII.–XVIII. Reviewed by DR. O. BRECHT, Berlin.

XIII.—LENS.

531. **Czermak.** Subconjunctival extraction with a conjunctival pocket. *Klin. Monatsbl. f. Augenheilk.*, xli., 11, 497.

532. **Hirschberg.** An important point in operations on soft cataract. *La clinica oculista*, Jan., 1904.

533. **Maggi.** A case of abnormal color perception in a girl operated on for cataract. *Arch. di Ottalm.*, Sept., 1903.

534. **Pope.** Extraction of cataract in the Government Ophthalmic Hospital, Madras. *Indian Medical Gazette*, Sept., 1903.

535. **Würdemann** and **Black.** Surgical treatment of high myopia (second paper). *Jour. Amer. Med. Assoc.*, Nov. 28, 1903.

536. **Reik.** Why not employ intracapsular irrigation in cataract operation? *Ann. of Ophth.*, xii., p. 416.

CZERMAK (531) gives a detailed description of his subconjunctival extraction which he spoke of at the thirty-first meeting of the Heidelberg Society. The chief points are as follows:

1. Opening the anterior chamber and the capsule with a Graefe knife.
2. Making a large conjunctival pocket downward.
3. Completing the corneal section with scissors.
4. Extrusion of the lens.
5. Conjunctival suture.

HIRSCHBERG (532) operated on a traumatic soft cataract in a young man. Discission was followed by glaucoma due to the swelling of the large lens masses remaining and to the opening of the vitreous chamber. Recovery followed simple sclerotomy. He recommends when there are many residual cortical masses to postpone discission. It sometimes suffices to incise the cornea with a lance and remove the masses.

CIRINCIONE.

MAGGI'S (533) patient, a girl of twenty-five, whose left eye was operated on for traumatic cataract, which developed in her ninth year while she was studying colors, confounded red and green with the eye operated upon, while with the healthy eye color perceptions were normal. CIRINCIONE.

POPE (534) has for some time discarded a bandage in the after-treatment of cataract extraction. He uses now a shade only. Of 1235 extractions there were 6.6 % of failures, and in 4.3 % prolapse of the iris took place. He does not definitely state if the operation is done without iridectomy though these results favor this idea. MARSHALL.

WÜRDEMANN and BLACK (535) report three cases operated upon by removal of the lens in high myopia, with satisfactory results. The method used was discission and evacuation in case of rapid swelling. ALLING.

XIV.—IRIS.

537. **v. Ewetzky.** On syphiloma of the ciliary body. *Reports of the Eye Clinic in Jurjeff*, vol. i., Berlin, Karger, 1904.

538. **Coppez and de Vaucleroy.** A case of primary sarcoma of the iris. *Rev. génér. d'opht.*, xxii., p. 433.

539. **Cirincione.** A procedure for breaking up posterior synechiæ. *La clinica oculista*, Aug., 1903, p. 1394.

540. **Poynton.** Some observations on the pathogenesis of rheumatic iritis. *The Ophthalmoscope*, Oct., 1903.

V. EWETZKY (537) in a monograph of 110 pages has given us a detailed clinical and anatomical description of syphiloma of the ciliary body based on four original observations and forty-seven reports in the literature. This diligently executed work throws much light on many questions for the dermatologist and the ophthalmologist.

COPPEZ and DE VAUCLEROY (538) saw a primary sarcoma of the iris in a patient forty-five years old. The eye was enucleated, the authors believing, for the usual reasons, that enucleation is preferable to removal of the tumor by iridectomy.

BERGER.

CIRINCIONE (539) to break up posterior synechiæ incises the periphery of the cornea with a Graefe knife, then through the incision passes iris forceps into the anterior chamber, seizes the iris, and makes violent traction. Usually the adhesion breaks. If it does not, the same manœuvre is performed from the opposite side. CIRINCIONE.

After investigating cases of rheumatic fever POYNTON (540) has succeeded in isolating a minute diplococcus from almost any part of the body of a patient suffering from this disease. Moreover when injected into rabbits it produces identical lesions to those in man, and in at least two cases irido-cyclitis resulted. This organism he believes to be the cause of the disease, and in rabbits it causes an irido-cyclitis indistinguishable from the similar condition in man.

The organism is a minute diplococcus which grows in chains in liquid media and in masses on solid. It does not liquefy gelatine,

but it clots milk with formation of acid. There are various other characteristics which show that it is not the staphylococcus.

MARSHALL.

XV.—CHOROID.

541. **Zur Nedden.** On tuberculous tumors of the choroid. *Klin. Monatsbl. f. Augenheilk.*, xli., II, p. 351.

542. **Reis, W.** Metastatic carcinoma of the choroid. *Ibid.*, xli., p. 411.

543. **Jackson.** A type of degeneration involving the central zone of the choroid and retina. *Trans. Amer. Ophth. Soc.*, 1903.

ZUR NEDDEN (541) reports two cases of tuberculous tumors of the choroid in girls of five and sixteen respectively. The diagnosis of tumor was first made when there became added to the severe inflammatory process a protrusion of the ball. No tuberculosis could be discovered elsewhere. A point of value in differential diagnosis is that tuberculosis in the eye has a tendency to invade the sclera early, to cause it to bulge, and to perforate it, which other tumors do not do.

REIS (542) describes a metastatic carcinoma of the choroid in a man of fifty-nine with a primary growth in the stomach. The course of the disease was rapid.

The author saw the case a week after vision began to fail and found a flat detachment of the retina. He was able to make the diagnosis before tumors could be found elsewhere. Three months later the eye became glaucomatous. This is the 44th case reported and the primary tumor was not in the breast as is usually the case.

JACKSON'S (543) case showed central choroidal atrophy and disturbance of pigmentation shading into normal fundus. The lesion appeared in both eyes, was congenital, and differed on the one hand from central coloboma of the retina and on the other from central chorio-retinitis.

ALLING.

XVI.—VITREOUS.

544. **Corda.** An interesting case of acute iodism with opacity of the anterior portion of the vitreous. *Annali di Ottalm.*, 1903, p. 277.

In CORDA'S (544) case a man of forty-three, after a week's treatment with iodide of potassium, exhibited lachrymation, photophobia, blepharospasm, and myosis—all relieved by the instillation of cocaine. In the anterior portion of the vitreous in each eye was a lamellar opacity. All these disturbances passed off in two days after the iodide was stopped.

CIRINCIONE.

XVII.—GLAUCOMA.

545. **Ring, H. W.** Report of a case of acute glaucoma incited by the use of euphthalmine for diagnostic purposes. *Trans. Amer. Ophth. Soc.*, 1903.

RING'S (545) patient, a woman of fifty-six, had a history of attacks of pain accompanied by reduction of vision in the left eye. The use of euphthalmine (5 %) brought on an attack of acute glaucoma two hours later. Iridectomy relieved the pain and the vision became normal.

Discussion.—H. KNAPP has had 3 cases; in all tension was reduced by eserine. ALLING.

XVIII.—SYMPATHETIC OPHTHALMIA.

546. **Rochat.** Sympathetic ophthalmia. *Report of the Ophthalmological Society of the Netherlands*, 1903.

547. **de Schweinitz** and **Shumway.** The lesions in a series of eyes which produced various types of so-called sympathetic disturbance in the fellow eye. *Proceed. Path. Soc. Phil.*, Apr., 1903.

ROCHAT (546) says that it is not only impossible to predict a sympathetic ophthalmia, but the disease surprises us by appearing when least suspected. The etiology is doubtful, and neither the idea of an excitation of the ciliary nerves nor the theory of Deutschmann is satisfactory. The belief that it is a specific disease is increasing in probability, and the experiences of recent years seems even more conclusive.

Rochat demonstrated three eyes enucleated after the development of sympathetic ophthalmia in the other eye. In all three were inflammatory foci, in which giant cells were found surrounded by epithelioid cells, greatly resembling tubercles, but never exhibiting caseation. It is of great importance to study the changes in the eye sympathetically affected in order to understand the significance of these foci in the eye first affected. But few such eyes have been examined. Two have been described previously, and one has been examined by Rochat. In three cases the same foci with the same giant cells and the same epithelioid cells have been found. These foci cannot be considered as being any of the well-known infectious granulomata. In fact there can be no question of tuberculosis, or syphilis, or lepra, or actinomycosis, or the like. Hence we must conclude that the active agent in the infection has not yet been discovered. JITTA.

DE SCHWEINITZ and SHUMWAY (547) give description of the examination of eight eyes which had produced sympathetic

irritation but not sympathetic inflammation. With one exception the eyes were destroyed by irido-cyclitis following perforating injury of the eyeball. The inflammation was not purulent, but plastic, accompanied by fibrin formation and later by organization of the exudation. The conditions were the same as those which produce sympathetic ophthalmia. Enucleation in every case, except one complicated by syphilis, had been followed by subsidence of the signs of irritation in the other eye.

ALLING.

Sections XIX.–XXII. Reviewed by DR. H. MEYER, Brandenburg.

XIX.—RETINAL AND FUNCTIONAL DISTURBANCES.

548. **Tarducci.** Subconjunctival injections of salt solution in cases of detachment of the retina. *Ann. di Ottalm.*, 1903.

549. **Hirschberg.** A case of glioma of the retina in both eyes. *Centralbl. f. Augenheilk.*, xxvii., p. 360.

550. **Nikoljukin.** Hemeralopia and its accompanying symptoms. *Wjest. ophth.*, 1903, No. 6.

551. **Fridenberg, Percy.** Vicarious menstruation into the retina followed by detachment and retinitis striata. *Trans. Amer. Ophth. Soc.*, 1903.

TARDUCCI (548) confirms the negative results obtained by others from subconjunctival salt injections in cases of detachment of the retina. CIRINCIONE.

HIRSCHBERG (549) observed a case of glioma in each eye of an otherwise healthy infant of ten months. The three nodules in each eye were arranged in trefoil fashion. Glaucomatous symptoms had begun. Hirschberg declined to operate on the grounds that the patient lives only when the white reflex has not been noticed longer than six or at the most ten weeks, and that in cases of enucleation of both eyes of glioma recurrence is the rule.

In sixteen years' observation in the Petro-Pavlovk district, NIKOLJUKIN (550) has seen regularly in the first half of the year a number of cases of hemeralopia among the peasants. The affection is commonly observed first in February, reaches its maxim in April, and is gone by August. When the crops have been poor the hemeralopia is more frequent, and is found with scurvy and anæmia. Lack of vegetable food is the chief cause. Malaria is not a factor. With the hemeralopia there is

often xerosis of the conjunctiva and cornea, anæsthesia of these parts, and ulceration of the cornea. HIRSCHMANN.

The case of a girl of fifteen is described by FRIDENBERG (551). There was a history of sudden defect of vision in one eye coincident with the first menstruation. The disc margin of the right eye was found blurred, veins tortuous, and vision $\frac{3}{200}$. Two hemorrhages were on the inferior temporal vein. In the macular region there were a few glistening spots. In connection with a subsequent suppression of menstruation fresh hemorrhages appeared, and later the retina became detached over the entire temporal half of the fundus, and striations were seen under the detachment and in the clear retina. Physical examination showed no systemic disorder. ALLING.

XX.—OPTIC NERVE.

552. **Faber** (Deventer). Papillæ conicæ. *Report of the Ophth. Soc. of the Netherlands*, 1903.

553. **Jocqs.** Retrobulbar neuritis. *Bull et mém. de la soc. franç. d'opht.*, 1903, p. 231.

554. **de Lapersonne** and **Opin.** Circumpapillary sarcoma. *Soc. d'opht. de Paris*, Oct. 13, 1903.

555. **Stocké.** A case of embolism of the central artery of the retina in each eye. Restoration of vision. *Medisch. Weekblad*, 1903, No. 39.

556. **Wilmer.** Report of a case of double traumatic optic neuritis, followed by absolute blindness and recovery. *Trans. Amer. Ophth. Soc.*, 1903.

FABER (552) has observed a form of nerve head which he calls papilla conica. The anomaly he has observed is the opposite to excavation of the disc. It is recognized by the elevation of the papillary vessels and ranges from 0.25 to 1. D. He has observed 40 such discs in persons with healthy as well as diseased eyes. He concludes:

1. The existence or the development of a conical disc need have no connection with functional disturbances of the eye.

2. Conical disc may arise from degenerative processes in the optic nerve. JITTA.

JOCQS (553) reports two cases of acute retrobulbar neuritis as a result of "cold." The first case was in a woman of thirty-eight, who had first several attacks of diplopia, followed by left internal ophthalmoplegia with ptosis, from which she recovered within a month. Two weeks later a central scotoma was found in the left eye, and three months later there was

atrophy of the optic nerve with perception of light in the periphery of the field only. The second case was in a man of eighteen, in whom, after exposure, a central scotoma appeared in the right field and completely disappeared. The writer believes that the complication of an acute retrobulbar neuritis with paralyses of the ocular muscles renders the prognosis of the former affection less favorable. BERGER.

DE LAPERSONNE and OPIN (554) observed in a woman of forty-two a circumpapillary sarcoma which appeared as a gray elevation sharply defined against the red of the normal fundus and with dilated retinal veins upon it. There was no evidence of detachment of the retina. The onset of glaucoma confirmed the diagnosis and the eye was enucleated. The tumor was a pigmented, spindle-celled sarcoma, surrounding for a distance of 15*mm* the disc, which was but slightly involved.

V. MITTELSTÄDT.

STOCKÉ'S (555) patient was a man of fifty-two, who had become blind in both eyes half an hour before the examination. A diagnosis was made of embolism of both central arteries of the retina. The patient had mitral insufficiency and atheroma. Stocké ordered digitalis, strophanthus, and the like. The following day the patient could see a little, and two days later vision was normal again. JITTA.

XXI.—INJURIES, FOREIGN BODIES, PARASITES.

557. **Bär.** A case of gun-cap injury. *Arch. f. Augenheilk.*, xlix., p. 60.

558. **Tschemolossoff.** On hemorrhages in the retina in cases of pernicious anæmia, due to tænia lata. *Wratsch*, 1903, No. 48.

559. **Würdemann.** Clinical observations on a probable case of cysticerci, occurring in both eyes. *Ann. of Ophth.*, Oct., 1903.

BÄR (557) reports a case of gun-cap injury, in which the sclera was perforated 4*mm* from the corneal margin. The splinter rebounded from the macula and lay between the macula and disc. An abscess formed about the foreign body in the vitreous, and connective tissue surrounded this. An attempt to remove the foreign body after an incision with a lance was unsuccessful. Some time later the abscess became displaced in the vitreous, and detachment of the retina followed and on account of beginning phthisis the ball was enucleated.

TSCHEMOLOSSOFF (558) had the opportunity to observe two new cases, besides the four he had previously reported, of extra-

vasations of blood in the retina in anæmia due to tænia lata. Death occurred in the two new cases, and one eye was examined microscopically. He found round and striated retinal hemorrhages and crescentic præretinal hemorrhages. These occur regularly in pernicious anæmia about the posterior pole of the eye, near the vessels, and are of prognostic importance.

They occur by diapedesis, are absorbed, leaving no trace, and are not accompanied by retinal inflammation. They are found mostly in the nerve-fibre layer. A swelling of the nuclei of the endothelial cells in the intima of the smaller vessels is observed.

HIRSCHMANN.

WÜRDEMANN (559) reports the case of a man of twenty-four, a native of Tennessee, who had worked on a ranch in Texas and lived upon insufficiently cooked meat. He presented detachment of the retina in the lower half of the right eye fundus, with marked retinitis proliferans. In the left, near an artery, a bottle-shaped cyst was observed. The head was free, and had six hooklets. There was no further disturbance in the eye. The author believes that the condition found in the right eye resulted from the presence of a cysticercus. If this is true, the case is the second on record in which cysticerci developed in both eyes. The further progress of the case could not be followed.

ALLING.

XXII.—OCULAR DISTURBANCES IN GENERAL DISEASES.

560. **Antonelli.** Optic neuritis in the course of acute infections. *Arch. d'opht.*, xxiii., No. 10, p. 633, and No. 11, p. 732.

561. **Darier.** New dental stigmata of hereditary syphilis. *Bull. et mém. de la soc. franç. d'opht.*, 1903, p. 216.

562. **Volbracht.** A contribution to the question of hepatic ophthalmia. *Zeitschr. f. Augenheilk.*, 1903, Oct., p. 358.

563. **Le Roux.** Ocular complications of mumps. *Arch. d'opht.*, xxiii., 10, p. 655.

564. **Chevallereau.** A case of sudden atrophy of the optic nerve, after uterine hemorrhages. *Bull. et mém de la soc. franç. d'opht.*, 1903, p. 280.

565. **Mörchen.** The symptoms of disease of the optic thalamus, particularly with reference to the eye. *Zeitschr. f. Augenheilk.*, x., p. 272.

566. **Bull, C. S.** Lesions of the eye which occur in the course of diseases of the heart, the blood-vessels, and the kidneys. *Med. Record*, Dec. 5, 1903. (An excellent review of the changes in the eye due to disturbances of the general circulation, giving useful diagnostic signs for the practitioner.)

In the continuation of his paper on the infectious diseases that are sometimes followed by optic neuritis, ANTONELLI (560) takes

up diphtheria, in which the toxic infection of the optic nerve proceeds directly from the naso-pharynx. In erysipelas of the face without involvement of the orbit, the action of the toxin may be immediate, since optic neuritis has not been observed after erysipelas of other parts of the body. Optic neuritis may follow mumps, though complete atrophy is rare. In the infectious polyneuritis of beri-beri, the optic nerve became affected as in the ordinary form of the disease. Zona ophthalmica may be complicated with ocular-muscle paralyses, and also by optic neuritis of toxic origin. It has never been seen with pneumonia.

In acute articular rheumatism, optic neuritis occurs, but in the chronic forms it is caused by the disturbances of nutrition, as in the cachexias of various sorts.

The optic nerve is especially susceptible to the action of various toxins, both because of its connection with the brain and because of its anatomical structure as a peripheral nerve, and, furthermore, on account of the favorable conditions for stasis at the optic foramen, and finally because of its peculiar blood supply.

Almost all acute infectious diseases may cause a retrobulbar neuritis or papillitis, even if the infection be of short duration.

v. MITTELSTÄDT.

DARIER (561), in a number of cases of hereditary syphilis in which there were no Hutchinson's teeth, found a lack of development of the enamel on the crowns of the molars.

BERGER.

VOLBRACHT (562) reports a case and gives a résumé of the literature. He concludes that the ocular disturbances found in liver disease with profound icterus and chronic progressive general disturbances and cachexia, are not so much due to a mixture of bile with the blood as to a possible bacterial invasion.

SCHWEIGGER.

LE ROUX (563) observed in a soldier with mumps a diminution of vision to $\frac{1}{4}$, with a central scotoma for red and green. There was nothing to be seen in the fundus, and complete recovery took place. There was a retrobulbar neuritis similar to that produced by alcohol and tobacco which here could be excluded.

CHEVALLEREAU (564) found in a woman of thirty-eight, after severe uterine hemorrhages, a sudden blindness of the left eye, and twenty-four hours later of the right. The discs were pale and there were hemorrhages about the discs. Pupils dilated

and unresponsive. A month later the discs were atrophic, and V = 0. The author has collected the literature of the subject. The great loss of blood causes an ischæmia of the retinal vessels, which leads to an optic-nerve atrophy. BERGER.

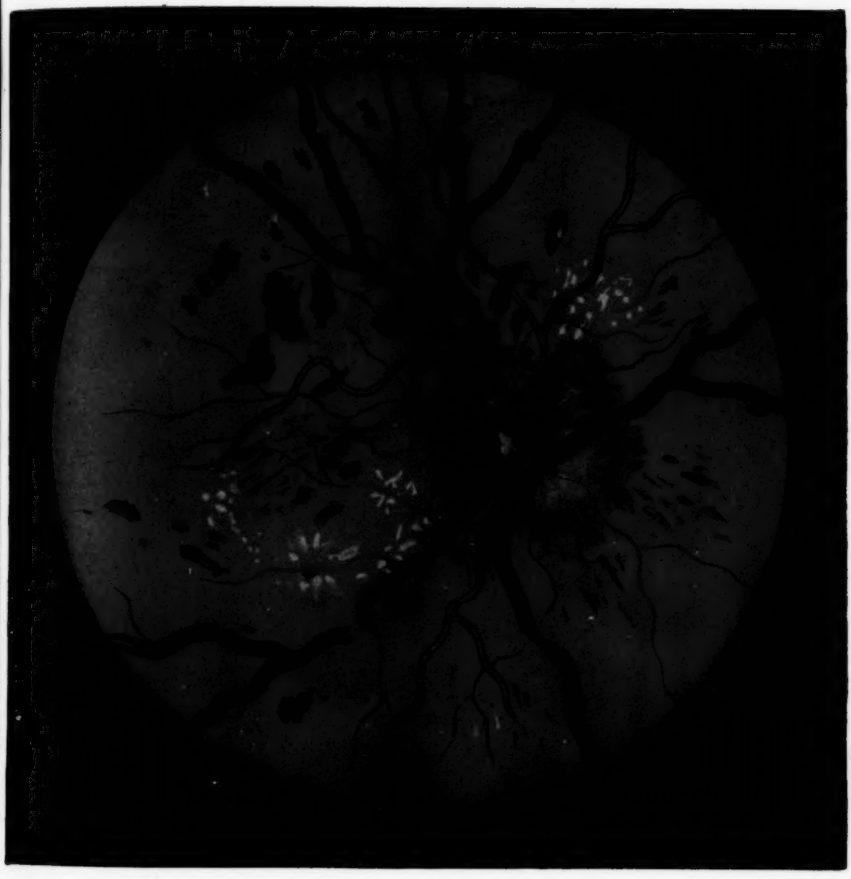
MÖRCHEN (565) has collected all the literature since 1890 which treats of the symptoms characteristic of disease of the thalamus, fifty-six cases having been reported. His conclusions are as follows:

1. The clinical observation of diseases of the thalamus has given us no ideas as to its structure and function.

2. No characteristic complexus of symptoms exists, nor does a characteristic individual symptom, except perhaps the mimic facial paralysis.

3. The diagnosis of disease of the thalamus may in some cases, particularly those with mimic facial paralysis, be made from symptoms due to the affection of neighboring parts.

4. The thalamus is of no particular importance as regards the functions of the visual apparatus. V. MITTELSTÄDT.



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